UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences
School of Health Care Sciences
Department of Physiotherapy

Cervical pain and the association thereof with scapula and cervical dyskinesis in Grade 7 learners in private schools in Tshwane.

by

Annelie van Heerden

Research dissertation submitted in fulfilment of the requirements for the degree Masters in Physiotherapy (MPhysT)

Supervisor

Dr F.E. Korkie

July 2019

DECLARATION BY RESEARCHER

I declare that this study: "Cervical pain and the association thereof with scapula and cervical dyskinesis in Grade 7 learners in private schools in Tshwane" is my own work. It has been submitted for the fulfulment of the degree MPhysT to the University of Pretoria. It has not been submitted before for any other degree or examination at this or any other university.

A van Heerden Date

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28 May 2019

Ms A van Heerden

95030256

Editing: *The presence of cervical pain and the association with scapula and cervical dyskinesis in Grade 7 learners in private schools in Tshwane.*

This letter serves to confirm that the above work was edited during May 2019 for submission in fulfilment of the MPhysT degree within the Department of Physiotherapy, of the Faculty of Health Sciences, at the University of Pretoria. The editing process focussed on ensuring consistent and correct use and writing of English grammar, language and punctuation.

Rhodé Odendaal

+27 71 463 3441

rodendaal@icloud.com

MIS Publishing, University of Pretoria

ABSTRACT

Cervical pain is a common musculoskeletal condition that starts as early as adolescence and continues on into adulthood. Cervical pain in the adolescents is present worldwide and affects between 18-40% of all adolescents. Contributing factors to cervical pain vary from sex, an increase in age, emotional and psychological problems to sustained seated positions and sitting posture as well as the use of information technology.

An association between cervical pain and scapula- and cervical dyskinesis has been seen in the adult population. The treatment of the dyskinesis in adults led to a significant decrease in cervical pain.

Clinically, if scapula- and cervical dyskinesis is present potential strain on the cervical spine could lead to cervical pain and dysfunction. A possible association between scapula- and cervical dyskinesis and cervical pain in adolescents has not been explored. Furthermore, limited literature is available about the presence of cervical pain in South African adolescents.

The purpose of this study was twofold; firstly, it was to determine the presence of cervical pain in Grade 7 learners in private schools in Tshwane, Gauteng, South Africa. Secondly, it was to determine the association of cervical pain with scapula- and cervical dyskinesis in the Grade 7 participants.

Four private schools in the greater Tshwane took part in the study with a total of 123 Grade 7 learners participating. The learners had a mean age of 12.97 years. The data collection took place at the various schools in October and November 2016. The participants completed a questionnaire on cervical pain and questions on certain previously determined factors related to cervical pain. The Scapula Dyskinesis Test (SDT) and Overhead Arm Lift Test (OALT) were used to determine scapula and cervical dyskinesis.

Descriptive statistics was used to determine mean, standard deviation, frequency, proportion and cross tables. The primary objective (the association between cervical pain and scapula and cervical dyskinesis) was assessed using a multivariable logistic regression analysis.

The research indicated that 21% of all learners presented with cervical pain on the day of data collection. There was an increase in the presence of cervical pain reported in the previous week (36%) and previous three months (52%) in the learners.

Significantly more girls than boys presented with cervical pain (p=0.04). As in previous studies, the current study also showed an increase in cervical pain with an increase in age (p=0.054).

Significant associations were found between cervical pain and related factors. The study showed significant associations between cervical pain and headaches (p>0.001) as well as several seated activities. Seated activities include using information technology (IT) for homework (p=0.004), recreational use of IT (p=0.009) and playing TV games (p=0.018).

A high percentage of learners presented with scapula- and cervical dyskinesis. However, the study did not find any association between cervical pain and scapula- and cervical dyskinesis.

Even though there was no association found between scapula and cervical dyskinesis and cervical pain, the impact of the high prevalence of dyskinesis is worth considering regarding the increased incidence of cervical pain in adolescence.

Keywords: Cervical pain, scapula dyskinesis, cervical dyskinesis, adolescents, Tshwane, information technology

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GLOSSARY

Table 1.1: Definition of key terms as used in the study

Adolescents	Individuals aged between 12 and 18 years of age.
Cervical spine	"The seven vertebrae of the vertebral column located in the neck" (Marieb, 2004).
Cervicothoracic area	The neck and upper back area (Straker, O'Sullivan, Smith and Perry, 2009).
Cervical dyskinesis	The inability of the cervical spine to control movement and position with or without movements of other parts of the body.
Dyskinesia	"Disorders of muscle tone, posture or involuntary movements" (Marieb, 2004).
Experienced physiotherapists	Physiotherapists with an OMT1 diploma and more than 10 years' experience.
Glenohumeral joint	The joint between the humerus and the glenoid fossa known as the shoulder joint (Marieb, 2004).
Glenohumeral flexion	Sagittal plane movement of the arm, lifting the arm forward (Marieb, 2004).
Glenohumeral abduction	Movement away from the body in a frontal plane, lifting the arm sideways (Marieb, 2004).
Ideal scapula resting position	The position of the scapula where the surrounding muscles is in the ideal length-tension relationship to ensure stability and control during scapular movements.
Ideal cervical spine posture	The position of the cervical spine where the ear is in line with the glenohumeral joint and the cervical discs and joints are in a neutral position. This will give the cervical musculature the correct length-tension relationship to ensure optimal stability and control during movement.
Scapula dyskinesis	The control of the scapula-thoracic joint with movement at the glenohumeral joint. "Relates to changes glenohumeral (GH) angulation, acromioclavicular (AC) joint strain, subacromial space dimension, shoulder muscle activation and humeral position and motion" (Kibler, Ludewig, McClure, Michener, Bak and Sciascia, 2013).
Scapula stabilisers	Serratus anterior and (lower fibres of) the trapezius muscles that control the position and function of the shoulder blade (Andersen, Andersen, Zebis and Sjøgaard, 2014),
Scapula-thoracic joint	The pseudo-joint between the shoulder blade and the chest wall, normally describing the movement of the

	shoulder blade relative to the chest wall (Sahrmann, 2001).
Stability exercises	Exercises that focus on improving cognitive control of movement at a specific area/ joint (Comerford and Mottram, 2012).
Tshwane	The city and geographical borders as determined by the South African government.
Upper quadrant musculoskeletal pain	Pain in the neck and shoulder area (Brink, Crous, Louw, Grimmer-Somers and Schreve, 2009b).

CHAPTER ONE

1. INTRODUCTION

1.1 INTRODUCTION

Cervical pain is a common musculoskeletal condition (Cohen, 2015). More than 30% of adults are annually affected by cervical pain (Hoy, Protani, De and Buchbinder, 2010). In adults, cervical pain is the fourth highest disease in terms of years living with disease (Murray, Atkinson, Bhalla, Birbeck, Burstein, Chou et al., 2013).

Cervical pain can start as early as childhood and adolescence (Aartun, Hartvigsen, Wedderkopp and Hestbaek, 2014). Existing evidence suggests that the presence of musculoskeletal pain in children increases into adolescence and then into adulthood (Mikkelsson, El-Metwally, Kautiainen, Auvinen, Macfarlane and Salminen, 2008; Aartun et al., 2014). This is a concerning fact as pain in adolescence is linked to chronic, generalised pain in adults (El-Metwally, Salminen, Auvinen, Kautiainen and Mikkelsson, 2004).

Limited information about the prevalence of cervical pain amongst South African adolescents is available. Three South African studies have been done. The first study, done in Kwazulu-Natal, reported cervical, lumbar and/or shoulder pain in approximately 86.9% of the population (Puckree, Silal and Lin, 2004). A second study, done in the Western Cape, reported a prevalence of 20% in cervical pain among 14- to 16-year-olds (Smith, Louw, Crous and Grimmer-Somers, 2009). The third study, done in Gauteng, reported a prevalence of 53.6% in cervical pain (Rhoda and Mafanya, 2011). No other studies on the proportion of cervical pain in children or adolescents in South Africa are available.

Cervical pain in adolescents appears to be multifactorial (El-Metwally et al., 2004; Murphy, Buckle and Stubbs, 2007; Smith et al., 2009). Psychosocial factors contributing to cervical pain include gender, emotional problems, depression and a family history of cervical and lumbar pain (Diepenmaat, van der Wal, de Vet and Hirasing, 2006; El-Metwally, Halder, Thompson, Macfarlane and Jones, 2007a; Straker, Smith, Bear, O'Sullivan and de Klerk, 2011). Environmental and physical factors identified include perceived school bag weight, quality and quantity of sleep, and prolonged periods of sitting (Auvinen, Tammelin, Taimela, Zitting and Karppinen, 2007; Haselgrove, Straker, Smith, O'Sullivan, Perry and Sloan, 2008; Auvinen, Tammelin, Taimela, Zitting, Järvelin, Taanila et al., 2010; Straker et al., 2011).

Furthermore, there is evidence that the use of computers and other forms of information technology (IT) is associated with musculoskeletal discomfort in adolescents (Ramos, James and Bear-Lehman, 2005). There has also been an increase in the percentage of the population using touch screen smart phones and tablet devices (Müller, Gove, Webb and Cheang, 2015). Recent epidemiological studies have reported a high prevalence of upper quadrant musculoskeletal pain (UQMP) among smart phone users (Berolo, Wells and Amick III, 2011; Shan, Deng, Li, Li, Zhang and Zhao, 2013).

In the adult population a correlation between cervical pain, position and muscle activation was found (Falla, Bilenkij and Jull, 2004; HelgadoTTir, Kristjansson, Mottram, Karduna and Jonsson Jr, 2010; Yoo, 2014). The presence of cervical pain, like shoulder pain and pathology, is associated with scapular dyskinesis (Castelein, Cools, Bostyn, Delemarre, Lemahieu and Cagnie, 2015; HelgadoTTir et al., 2010; Kibler et al., 2013; Thigpen, Padua, Michener, Guskiewicz, Giuliani, Keener et al., 2010).

The relation between cervical pain, and scapula and cervical dyskinesis in adults correlates with movement control theories as developed by authors such as Shirley Sahrmann (2001), Mark Comerford and Sarah Mottram (2012).

Several studies indicate a significance in pain reduction when addressing scapula dyskinesis in adults with cervical pain. Andersen et al. (2014) reported decreased pain levels in subjects with non-specific cervical pain after training of the scapular stabilising muscles. A study by Desai, Khatri and Agarwal (2013) showed that correction of the scapula posture leads to immediate reduction in pain levels in patients with acute onset of neck pain. Postural education combined with cervical and scapula exercises also showed a decrease in cervical pain (Koh, Park, Park, Park, Jeon, Kim et al., 2014).

It is unknown if intervention by addressing scapula dyskinesis, as done in the adult population, will have the same effect in adolescents. As there is a significant reduction of cervical pain when dyskinesis is addressed, it is important to explore this specific aspect of scapula and cervical dyskinesis as it relates to cervical pain in adolescents.

In light of existing literature the study will investigate the prevalence of cervical pain as well as scapula- and cervical dyskinesis in Grade 7 learners in private schools in Tshwane, Gauteng, South Africa.

The mean age of Grade 7 learners is 13 years, the beginning of adolescence. According to previous literature, cervical pain increases during this time for adolescents (El-Metwally et al., 2007a; Mikkelsson et al., 2008; Aartun et al., 2014) and it will therefore be of significant value to determine the prevalence of cervical pain as well as scapula- and cervical dyskinesis amongst Grade 7 learners.

1.2 PROBLEM STATEMENT

Cervical pain in children and adolescents is a common musculoskeletal disorder with multiple factors contributing to the pain (El-Metwally et al., 2007a; Hellstenius, 2009; Aartun et al., 2014). These factors include psychosocial, physical and environmental factors (Diepenmaat et al., 2006; Haselgrove et al., 2008; Smith et al., 2009; Straker et al., 2011; Ruivo, Pezarat-Correia and Carita, 2014; Brink, Louw, Grimmer and Jordaan, 2015;

Xie, Szeto, Dai and Madeleine, 2016). One factor that has not been explored is the influence of scapula and cervical dyskinesis on adolescents with cervical pain. No known studies are available on the dynamic posture, movement and control (kinesis) of the scapula and cervical spine in adolescents. In adults, an association between cervical pain, and cervical and scapula dyskinesis is evident (HelgadoTTir et al., 2010; Cagnie, Struyf, Cools, Castelein, Danneels and O'Leary, 2014; Castelein et al., 2015). There is reliable evidence in the literature that scapula stability training and postural education leads to a decrease in cervical pain (Desai et al., 2013; Andersen et al., 2014; Koh et al., 2014).

These findings lead to the development of the second aspect of the study. Although cervical pain related to altered cervical alignment, and cervical and scapular muscle activation in adults has been explored, this has not been investigated in children and adolescents.

In children, the resting position of the scapula differs from that of adults (Struyf, Nijs, Horsten, Mottram, Truijen and Meeusen, 2011). There is also a difference in the dynamic position and movement of the scapula when compared to the adult scapula (Dayanidhi, Orlin, Kozin, Duff and Karduna, 2005). However, the quality of movement of the scapula against the thorax, while glenohumeral movement is taking place, does not appear to be different (Struyf et al., 2011).

There is limited literature available about cervical pain in adolescents in South Africa. To the knowledge of the researcher, only three studies were done in South Africa. The proportion of cervical pain was reported to be at least 20% in South African adolescents (Puckree et al., 2004; Smith et al., 2009; Rhoda et al., 2011).

This leads to questioning the presence of cervical pain in Grade 7 learners in private schools in Tshwane, Gauteng, South Africa.

Furthermore, it is not known whether there is an association between cervical pain and the presence of cervical and scapula dyskinesis in adolescents. To the knowledge of the researcher, these aspects have not been explored by existing literature.

1.3 RESEARCH QUESTIONS, AIM AND OBJECTIVES

<u>RESEARCH QUESTIONS</u>:

1. What is the proportion of cervical pain in Grade 7 learners in private schools in Tshwane, Gauteng, South Africa?

2. Is there an association between cervical pain and the presence of cervical and scapula dyskinesis in the relevant Grade 7 learners?

<u>AIMS AND OBJECTIVES</u>

Primary aim:
To determine the proportion of Grade 7 learners with cervical pain in private schools in Tshwane, Gauteng, South Africa.

Secondary aim:
To determine if there is an association between cervical pain and the presence of cervical and scapula dyskinesis in the relevant Grade 7 learners.

Objectives:

- To determine the proportion of scapular dyskinesis in the Grade 7 study population by means of video analysis.
- To determine the proportion of cervical pain in the Grade 7 study population by means of a personal questionnaire and an adapted young spine questionnaire.
- To determine the proportion of cervical dyskinesis in the Grade 7 study population by means of video analysis.
- To determine the association of cervical pain with cervical dyskinesis in the Grade 7 study population.

- To determine the association of cervical pain with scapula dyskinesis in the Grade 7 study population.
- To determine the association between cervical pain and seated, recreational and educational activities in the Grade 7 study population.

1.4 IMPORTANCE AND BENEFITS OF THE PROPOSED STUDY

This study will be important to the physiotherapy profession, the educational sector and the healthcare sector.

The information gained from the study will contribute to the pool of knowledge about musculoskeletal pain in adolescents and by investigating dyskinesis, could potentially find another contributing factor to cervical pain.

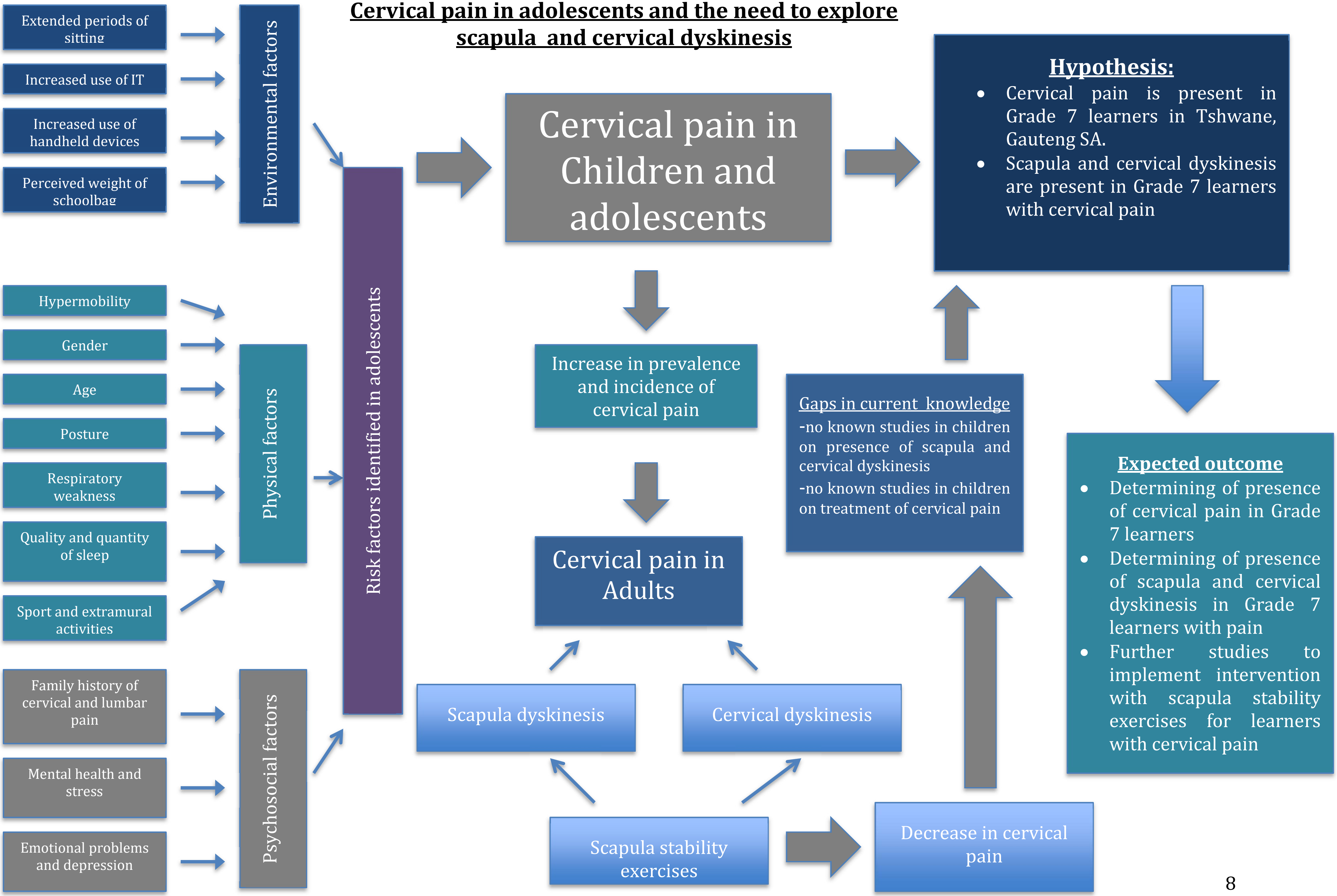
According to existing literature cervical pain increases in adolescence (El-Metwally et al., 2004). The proposed study will be done on Grade 7 learners, at the beginning of adolescence, and will be of importance to determine the prevalence of cervical pain. As there has never been a study done in Gauteng on the presence of cervical pain in Grade 7 learners the information from the study could give insight into the epidemiology of cervical pain amongst adolescents in South Africa.

Many aspects of pain in adolescents have been explored and will be discussed in the literature study. Despite the extensive research done in adolescents to determine various contributing factors, the position and dynamic stability of the scapula and cervical spine have not been investigated. As these are physical components potentially contributing to cervical pain, the appropriate therapeutic intervention could be of significant value. This has been proven in studies done in adults where cervical pain was addressed by rehabilitation of the scapular and cervical stabilising muscles (Desai et al., 2013; Andersen et al., 2014; Cagnie et al., 2014).

No previous, relevant studies on cervical pain, and cervical and scapula dyskinesis, targeting the age of the intended study population, have been done in South Africa.

1.5 CONCEPTUAL FRAMEWORK

Cervical pain in adolescents and the need to explore scapula and cervical dyskinesis



1.6 ASSUMPTIONS

It is assumed that all the participants use similar school furniture. Furthermore, it is assumed that none of the participants have major disabilities with regards to sight, mobility and intellect, as they are attending mainstream schools. Another assumption is that all learners are fluent in English language reading and writing, as they are attending English or dual medium mainstream schools. It is assumed that for all participants, time spent in class and on homework is the same.

1.7 DELIMITATIONS

Only private schools are used for the study. These schools are distributed across the greater Tshwane, Gauteng, South Africa.

1.8 DEFINITION OF KEY TERMS

See Glossary page xvi

1.9 OUTLINE OF THESIS

<u>Chapter 2</u>

The relevant literature, which forms the foundation for the clinical reasoning and research questions in the study are discussed. The literature study gives the background to the reasoning for the study.

<u>Chapter 3</u>

The methodology used to conduct the study is described, in order to explain the relevancy of the chosen questionnaires and tests.

<u>Chapter 4</u>

The results from the study are presented, analysed and interpreted. This is necessary to present all findings. The statistically significant findings are highlighted in Chapter 5.

Chapter 5

The results of the study are discussed in light of the background literature and the research findings. Significant findings are highlighted, interpreted and discussed to indicate and prove the relevance of the study.

Chapter 6

Limitations and recommendations of the study are discussed. The limitations will be to inform the reader of known non-ideal aspects of the study.

Recommendations in light of the findings in the study are focused on. This includes clinical application and the need for further research and intervention studies.

Chapter 7

The thesis is concluded in Chapter 7. New knowledge from the study is emphasised and integrated with currently available literature.

1.10 SUMMARY

In Chapter 1 the background of the study was presented. Furthermore, the research questions, aims, objectives, and formulated hypothesis were discussed.

In Chapter 2 is the literature is reviewed. Available literature is analysed in order to justify the use of the proposed physical tests and questionnaires necessary to successfully complete the study and prove its validity.

CHAPTER TWO

2. LITERATURE STUDY

2.1 INTRODUCTION

In Chapter 1 the background, research questions, aims, and significance of the study were explained to clarify the value of the research study. In this chapter existing literature on cervical pain in adolescents, the factors contributing to cervical pain, cervical and scapula dyskinesis, and the treatment of cervical pain in adolescents are discussed. The aim of the chapter is to lay the foundation by discussing the currently available literature, identifying existing gaps in the available literature and in so doing justify the value for conducting the research study.

2.2 LITERATURE FRAMEWORK

Firstly, the prevalence and incidence of cervical pain in adolescents will be discussed. This will be followed by a discussion of factors contributing to cervical pain in adolescents. The factors are grouped under school-related activities, physical activities, the use of information technology, psychological factors and demographic factors. Thirdly, cervical and scapula dyskinesis will be discussed. Fourthly, the evaluation of dyskinesis will be discussed followed by a summary of the literature review.

2.3 PREVALENCE AND INCIDENCE OF CERVICAL PAIN IN ADOLESCENTS

A literature search on PubMed, Medline and Google Scholar was conducted to find articles related to the prevalence of cervical pain in adolescents. The following key words were used: “cervical pain”, “neck pain”, “adolescent”, “children”, “prevalence” and “incidence”. There was an increase in published studies on cervical pain in adolescents and relating factors during the early

2000s. Therefore, studies published since 2002 were included to ensure a comprehensive overview of past and currently available literature is provided.

Cervical pain is a common international musculoskeletal condition, affecting individuals from childhood to adulthood (Hoy et al., 2010; Murray et al., 2013; Vassilaki and Hurwitz, 2014; Cohen, 2015). Chronic cervical pain is present in the population of both developed and developing countries (Tsang, Von Korff, Lee, Alonso, Karam, Angermeyer et al., 2008; Cohen, 2015).

Worldwide studies have been done to investigate cervical pain in adolescents (El-Metwally et al., 2004; Murphy et al., 2007; Murphy, Buckle and Stubbs, 2004; Diepenmaat et al., 2006; O'Sullivan, Beales, Jensen, Murray and Myers, 2011a; Dianat, Sorkhi, Pourhossein, Alipour and Asghari-Jafarabadi, 2014; Jussila, Paananen, Näyhä, Taimela, Tammelin, Auvinen et al., 2014; Myrtveit, Sivertsen, Skogen, Frostholm, Stormark and Hysing, 2014; Shan, Deng, Li, Li, Zhang and Zhao, 2014). Countries where studies on cervical pain in adolescents were conducted include Denmark, the United Kingdom (UK), the Netherlands, Australia, China and Finland.

In Denmark 8% of 11-year-olds and 35% of all 15-year-olds seek healthcare for spinal pain (Aartun et al., 2014). A UK study reported 27% of children between 11 and 14 years of age complained of cervical pain (Murphy et al., 2007). In a Dutch study of 3485 adolescents, 11.5% of the 12-16-year-olds experienced cervical pain (Diepenmaat et al., 2006).

The Raine study, a long-term research project in Western Australia, is aimed at collecting data on health and developmental issues in the participants at different periods throughout the course of the study (Haselgrove et al., 2008; Rees, Smith, O'Sullivan, Straker and Kendall, 2011; Straker et al., 2011). The Raine study began with a cohort of pregnant women attending ante-natal classes between 1989 and 1991 at the King Edward Memorial Hospital in Perth (Haselgrove et al., 2008). The association between mental health issues and cervical pain was investigated as part of the Raine study (Rees et al., 2011). More than 1500 Australian adolescents, with the mean age of 14.2

years, participated in the study. Approximately 15% of the adolescent study population reported cervical pain.

In Shanghai, China, 15- to 19-year-old high school children participated in a study on cervical pain (Shan et al., 2014). The study sample was large, with 3016 valid questionnaires that were collected. The study was conducted in three different year groups at the schools, and the prevalence of cervical pain was reported separately. The prevalence of cervical pain in Shanghai was reported as 39%, 40.9% and 45.8% respectively for school years 1, 2 and 3. The overall prevalence of cervical pain in this adolescent population group was 40.8% (Shan et al., 2014).

The first of three available South African studies was done in Kwazulu-Natal (Puckree et al., 2004). The study reported a prevalence of 86.9% in cervical, lumbar and/ or shoulder pain among 11- to 14-year olds. The second study was done in the Western Cape and reported a prevalence of 20% in cervical pain and 26% in headaches among 14- to 16-year-olds (Smith et al., 2009). Learners with a combination of cervical pain and headaches came to 7.1% of the population. The third study was done in Gauteng and reported a prevalence of cervical pain of 53.6% (Rhoda et al., 2011). The study was done among Grade 8-11 learners with an increase in the sample size for each higher year group. Grade 11 learners made up 45% of the study population. This had an effect on the prevalence seen in the study, as previous literature found that the prevalence of cervical pain increases with age (El-Metwally et al., 2004).

Cervical pain starts as early as childhood and adolescence (El-Metwally et al., 2004; El-Metwally et al., 2007a; Aartun et al., 2014). Evidence suggests that the prevalence of pain in childhood increases into adolescence and adulthood (Feldman, Shrier, Rossignol and Abenhaim, 2002; El-Metwally et al., 2004; Mikkelsson et al., 2008; Aartun et al., 2014; Ståhl, El-Metwally and Rimpelä, 2014). In a four-year follow-up study by El-Metwally et al. (2004) it was found that pre-adolescents with persistent musculoskeletal pain had a three times higher risk of pain recurrence (Odds Ratio=2.90. 95% confidence interval 1.9-

4.4). Pain in adolescence is linked to chronic, generalised pain in adults (El-Metwally et al., 2004).

A longitudinal study researching the two-year incidence of musculoskeletal pain in 11- to 13-year-olds in Finland, found progressive incidence of 60% for cervical pain, 49.8% for thoracic pain and 42% for lumbar back pain (Aartun et al., 2014). At the two-year incidence level, pain in multiple locations was reported regardless of where the initial pain was. Similar results were found by Shan et al. (2014) also indicating that the prevalence of cervical pain increases with years into adolescence. The prevalence increased from 40.07% for learners in grade 1 (15- to 17-year-olds) to 45.41% for learners in Grade 3 (17- to19-year-olds) (Shan et al., 2014).

From the available literature it is evident that cervical pain in adolescents varies between 8% and 40%. Evidence shows that childhood and adolescent cervical pain could contribute to chronic pain in adulthood, emphasising the importance of research of cervical pain prevalence in adolescence (El-Metwally et al., 2004; Mikkelsson et al., 2008). Not only did the researchers look at prevalence of cervical pain but also at contributing factors to the pain. These factors will now be discussed in more details.

2.4 FACTORS CONTRIBUTING TO CERVICAL PAIN IN ADOLESCENTS

2.4.1 INTRODUCTION

As in adults, cervical pain in adolescents appears to be multidimensional and multifactorial (El-Metwally et al., 2004; Murphy et al., 2004; Smith et al., 2009).

A PubMed, Medline and Google Scholar search was done using the following key words: “neck pain”, “cervical pain”, “risk factors”, “adolescents”, “children” and “prevalence”. Identified factors from the search included age, sex, posture, emotional and mental health issues, use of information technology, schoolbag weight, quality and quantity of sleep, physical and extramural activities and hypermobility. The studies identified in literature were appraised and the most relevant studies are summarised in Annexure A. Studies were included if the study was conducted on cervical pain, was done later than 2002, was conducted where the population age was between 12 and 18 and if the study was conducted in English. Twenty-eight studies, between 2002 and 2018, were identified as relevant. The articles were grouped according to significant findings in one of the following four areas: school related activities, physical activities and attributes, activities involving information technology and mental health.

The study done by Gustafsson, Thomée, Grimby-Ekman and Hagberg (2017) was included despite the age of the subjects being between 20-24 years, as the data collected is relevant to address the research question of the proposed study. There have been very few studies done in the adolescent population for texting on mobile phones and the study provided valuable insight on the topic of texting.

An outline of the factors contributing to cervical pain in adolescents as they are grouped together is found in Table 2.1.

Table 2.1 Factors contributing to cervical pain in adolescents

2.4.1 Introduction	
2.4.2 School-related activities	2.4.2.1 Schoolbag weight 2.4.2.2 Posture
2.4.3 Physical activities	2.4.3.1 Physical and extramural activities 2.4.3.2 Hypermobility
2.4.4 Use of information technology	
2.4.5 Psychological factors	2.4.5.1 Emotional and mental health issues 2.4.5.2 Quality and quantity of sleep
2.4.6 Demographic factors	2.4.6.1 Sex 2.4.6.2 Age
2.4.7 Conclusion	

2.4.2 SCHOOL-RELATED ACTIVITIES

The first group of the factors that contribute to cervical pain in adolescents are school-related activities. The factors affecting school related activities include: schoolbag weight and posture. Aspects related to schoolbag weight include: the physical schoolbag weight, the perception of schoolbag weight and the method for carrying of the schoolbag (load). Aspects related to posture include: seated posture, activities in sitting and posture while using information technology.

The first factor to be discussed regarding school-related activities is schoolbag weight.

2.4.2.1 SCHOOLBAG WEIGHT

Schoolbag weight is a one of the factors that have been investigated in the quest to determine the reason for cervical pain in adolescents. Aspects investigated regarding schoolbag weight include; the relationship between schoolbag weight and cervical pain, the perception of schoolbag weight and cervical pain and the method for carrying of schoolbags and cervical pain. Five relevant studies were identified in the literature (Puckree et al., 2004; Haselgrove et al., 2008; Dianat et al., 2014; Panicker and Sandesh, 2014; Rai and Agarwal, 2014). All five studies had large sample sizes (n=176-1202), were done in the adolescent population in different countries and investigated diverse aspects of schoolbags and cervical pain.

Schoolbag weight and cervical pain

The first aspect investigated was the relationship between schoolbag weight and cervical pain. To determine the presence of cervical pain and pain levels three of the four studies used valid and reliable questionnaires (Haselgrove et al., 2008; Dianat et al., 2014; Panicker et al., 2014).

In four studies physical measurements (body weight, height and schoolbag weight) were done (Puckree et al., 2004; Dianat et al., 2014; Panicker et al., 2014; Rai et al., 2014). No physical measurements were done in the Haselgrove et al. (2008) study. Therefore, the study is not taken into account with regards to the association between cervical pain and the actual schoolbag weight.

An association between cervical pain and schoolbag weight was found by Dianat et al. (2014); Panicker et al. (2014). A moderate correlation between pain and the weight of the schoolbag (OR=0.784) was found but there was no association found between Body Mass Index (BMI) and bag weight on cervical pain (Panicker et al., 2014). Furthermore, more than half of the subjects who reported pain stated the reason for cervical pain was prolonged sitting, indicating that classroom furniture and posture could also be contributing to cervical pain and not so much carrying schoolbags.

A significant association between cervical and shoulder pain and the physical weight of the schoolbag as a percentage of body weight was found (Dianat et al., 2014). However, the mean schoolbag weight in this study was only 7.1%

of body weight, despite the recommended schoolbag weight of 10-15% of body weight (Dianat et al., 2014). This raises the question if it was the actual schoolbag weight or subjective perception thereof that caused the cervical pain.

On the contrary, the study by Rai et al. (2014) determined the presence of musculoskeletal discomfort in the participating population, but no association between cervical pain and schoolbag weight was reported. However, these results can be questioned as the validity and reliability of the questionnaire used in the study is not available. The study by Puckree et al. (2004) found the presence of musculoskeletal pain in the cervical area and shoulders regardless of schoolbag weight. The study population was divided into those with bags heavier than 10% of their body mass and those with bags lighter than 10% of their body mass. The study found that the majority of learners had bags 10% or less than their body mass but a significantly larger number of these learners complained of some degree of spinal pain (Puckree et al., 2004).

From the relevant literature it is clear that the association between cervical pain and schoolbag weight is not solely determined by the physical weight of the schoolbag but also by other factors. One can question whether a broader combination of factors such as gender, individual body morphology, general muscle strength and physique plays a significant role in influencing the association between schoolbag weight and cervical pain.

<u>Type and duration of transport and contribution to cervical pain</u>

The second aspect investigated regarding schoolbags and cervical pain was the type and duration of transport of the learners to and from school and the subsequent contribution to cervical pain.

Children carrying schoolbags while walking or cycling to school had less pain than those who used bus or car transport (Haselgrove et al., 2008). Haselgrove et al. (2008) found a higher prevalence of perceived fatigue in the population using bus or car transport where the learners did not carry their bags to school. Dianat et al. (2014) found a significant association ($p<0.05$) between cervical pain and travelling to school with a bus or car, confirming the trend seen by Haselgrove et al. (2008). Passive transport (bus and car) was associated with cervical pain, suggesting that there is an inadequacy of muscle activation in this group compared to the active transport group (walking, cycling). Considering the theory of movement control and stability (Sahrmann, 2001) one could reason that walking or cycling to school could lead to the sufficient activation of postural muscles, having a positive effect on the carrying of schoolbags throughout the day.

Perception of schoolbag weight

The third aspect investigated in relevant literature is the perception of the schoolbag weight. Only one study assessed the perception of schoolbag weight (Haselgrove et al. 2008). The study identified perceived weight and perceived fatigue as the strongest indicators for spinal pain ($p<0.001$) (Haselgrove et al. 2008). As the study was cross-sectional by design, the factors contributing to the perceived weight and fatigue were not determined.

From the aspects discussed regarding schoolbags the conclusion is made that much more than the physical components of schoolbags play a role in an association with cervical pain. The mode of transport and the subjective perception of schoolbag weight are important factors when it comes to the association of schoolbag weight with cervical pain. This is in line with a study on the guidelines of safe schoolbag weight (Dockrell, Blake and Simms, 2016). The study determined that the ideal schoolbag weight could not be determined by the percentage of body weight nor the duration of carrying (the mechanical burden) of the schoolbag (Dockrell et al., 2016). From the literature it is evident that perception of schoolbag weight and individual abilities play a vital role in the association of schoolbag weight with cervical pain.

The second aspect to be discussed in school-related activities is posture.

2.4.2.2 POSTURE

Several aspects impact posture in adolescents. These aspects include seated posture, posture while using information technology and accumulative sitting time.

Firstly, cervical posture in sitting has been assessed in nine studies to determine its contribution to cervical pain in adolescents (Murphy et al., 2004; Breen, Pyper, Rusk and Dockrell, 2007; Brink, Hillier, Louw and Schreve, 2009a; Hellstenius, 2009; Straker et al., 2009; O'Sullivan, Smith, Beales and Straker, 2011b; Straker et al., 2011; Ruivo et al., 2014; Brink et al., 2015).

Five studies found a correlation between posture, specifically forward head posture and slump, and cervical pain (Murphy et al., 2004; Brink et al., 2009a; O'Sullivan et al., 2011a; Ruivo et al., 2014; Brink et al., 2015). Ruivo et al. (2014) found that cervical pain and dysfunction has a statistically significant association with a decreased cervical angle (forward head posture).

On the other hand, three studies found no significant association between cervical pain and any specific posture in sitting (Hellstenius, 2009; Straker et al., 2009; Straker et al., 2011). Even though posture was found to change over time, there was no association with pain (Straker et al., 2009). One finding was that a decreased lumbar angle was weakly predictive for cervical and shoulder pain ($p=0.048$), showing that cervical pain was related to more than just cervical posture (Straker et al., 2009).

The majority of the studies (Murphy et al., 2004; Hellstenius, 2009; Straker et al., 2009; O'Sullivan et al., 2011b; Straker et al., 2011; Brink et al., 2015) observed seated posture whereas the study of Ruivo et al. (2014) did postural observation in erect standing. There was no difference in the observation in standing posture compared to sitting posture. So regardless of the position of postural evaluation (with or without a stable basis as in sitting) there was no difference in the association with cervical pain (Ruivo et al., 2014).

Secondly, the influence of a sustained sitting posture, while using information technology, was assessed. Three studies investigated sitting posture over a period of time (Breen et al., 2007; Brink et al., 2009a; Straker et al., 2009). Only one study showed a significant deterioration in sitting posture while using technology (Breen et al., 2007). Straker et al. (2009) found a more rigid posture in participants while using computers. Brink et al. (2009b) conducted 10 minutes of dynamic posture analysis through the analysis of photographic measurements at 0 minutes, 5 minutes and 10 minutes and found that participants had more postural changes (especially in the head flexion angle) in the 10 minutes than the control group. However, the change in posture was not statistically significant.

It is evident that posture can be affected in different ways while being exposed to information technology. Learners with cervical pain present either with a significant change in posture or a more rigid posture while using IT, however posture on its own (while using IT) was not significantly related to cervical pain.

Thirdly, the association between prolonged sitting and upper quadrant musculoskeletal pain was assessed. Four studies found an association between prolonged static postures and cervical pain (Murphy et al., 2004; Auvinen et al., 2007; Brink and Louw, 2013; Shan et al., 2013). Prolonged sitting duration, between 50 and 60 hours per week for boys, and 60 to 70 hours per week for girls, was shown as a significant factor to the contribution of cervical pain (Brink et al., 2013) .

When comparing the studies it is noticeable that the duration of assessment could be the reason for the variances in the outcomes. This was evident in the studies of Brink et al. (2009a) and Shan et al. (2013). Fatigue over a long period of time played a significant role in the onset of non-ideal posture and pain. Perceived fatigue has also been found to be a strong identifier of spinal pain (Haselgrove et al., 2008). It could be argued that the cervical stabilisers fatigue after hours of sustained positions, hence the increase in cervical flexion.

In conclusion, from the existing literature it is clear that there is sufficient evidence that the accumulated duration of prolonged sitting postures contribute to cervical pain and not the postural position that was originally assumed.

The second group of factors affecting cervical pain in adolescents is physical activities and components.

2.4.3. PHYSICAL ACTIVITIES

Physical activities affecting cervical pain in adolescents include sport and extramural participation. Hypermobility is also classified under physical activities due to the physical component.

2.4.3.1 PHYSICAL AND EXTRAMURAL ACTIVITY

The factors relating to physical and extramural activities have been studied in the existing literature. Contrasting reports were found in literature about the association between cervical pain and physical and extramural activities.

Five studies investigated the association of physical activities with cervical pain (Feldman et al., 2002; Diepenmaat et al., 2006; Auvinen et al., 2007; Shan et al., 2013; Myrtveit et al., 2014). All five studies had large sample sizes varying between 502 and over 10000.

Three studies found that moderate physical activity lead to a reduction in cervical pain (Auvinen et al., 2007; Shan et al., 2013; Myrtveit et al., 2014). Two studies (Feldman et al., 2002; Diepenmaat et al., 2006) found no association between physical activities and cervical pain. However, one study that found a reduction in cervical pain with moderate physical activities indicated that high-level physical activities in girls lead to an increase in cervical pain (Auvinen et al., 2007).

Three studies (Auvinen et al., 2007; Shan et al., 2013; Myrtveit et al., 2014) agreed with a 7-year prospective study done by Siivola, Levoska, Latvala, Hoskio, Vanharanta and Keinänen-Kiukaanniemi (2004) which found that physical exercise is associated with lower prevalence of cervical pain.

In conclusion, most studies found that physical activities are associated with a decrease in the prevalence of cervical pain.

The next factor to be discussed is hypermobility. Even though it is not a physical activity it is a physical attribute that has an effect on the body when participating in physical and recreational activities.

2.4.3.2. HYPERMOBILITY

The factor of joint hypermobility has been assessed in the literature over several years as researchers hypothesised that there was an association between hypermobility and cervical pain (Mikkelsson, Salminen and Kautiainen, 1998; Feldman et al., 2002; El-Metwally et al., 2004; El-Metwally, Salminen, Auvinen, Macfarlane and Mikkelsson, 2007b; Mikkelsson et al., 2008; El-Metwally et al., 2007a; O'Sullivan et al., 2011a; Kumar and Lenert, 2017).

Although two studies found that hypermobility contributed to musculoskeletal pain in adolescents (O'Sullivan et al., 2011a; Tobias, Deere, Palmer, Clark and Clinch, 2013) the cervical spine is not one of the sites.

It is clear from the studies that hypermobility does not contribute to cervical pain, clarifying the perception about hypermobility and cervical pain (Mikkelsson et al., 1998; El-Metwally et al., 2004; El-Metwally et al., 2007b; Mikkelsson et al., 2008; Feldman et al., 2002; O'Sullivan et al., 2011a; Kumar et al., 2017).

The third group of factors contributing to cervical pain is IT activities. This includes the use of IT at school or for recreation and includes all IT devices.

2.4.4 USE OF INFORMATION TECHNOLOGY

Information technology activities include: the use of laptops and computers at school and at home, tablet use at school and at home, the use of mobile phones, watching television, using a handheld games console or tablet and playing TV games such as PlayStation and Xbox. There has been an increase in the use of touch screen smartphones and tablet devices in the general population but specifically in younger people (including adolescents) (Müller et al., 2015).

Several studies have investigated the relation between information technology and cervical pain and discomfort.

The evidence for an association between cervical pain and the use of information technology is strong for the usage of cell phones and tablets but conflicting evidence is available for the use of computers (Gustafsson, Johnson, Lindegård and Hagberg, 2011; Shan et al., 2013; Myrtveit et al., 2014; Gustafsson et al., 2017). As the use of mobile phones and tablets are increasing, it is a factor that cannot be underestimated (Berolo et al., 2011)

A significant association between the usage of computers and cervical pain was found in five studies ($p<0.01$-0.05, OR=1.95-2.0) (Ramos et al., 2005; Gustafsson et al., 2011; Shan et al., 2013; Myrtveit et al., 2014; Gustafsson et al., 2017). In contrast to the findings of the five studies no association between the use of computers and cervical pain was found in three studies (Diepenmaat et al., 2006; Straker et al., 2011; Brink et al., 2015). All studies had large sample sizes varying between n=211 and n=10220. Most studies used self-reported questionnaires, which brings into question the objectivity of the findings as self-reported questionnaires are inherently biased.

There were no clear differences in the methodologies of the studies that would lead to the contrast in findings. However, in the study by Brink et al. (2015) computer usage was reported as only about eight hours per week in the symptomatic and asymptomatic groups. The low hours of computer usage per week could be a possible reason for no association with cervical pain compared to the hours reported in other studies. Myrtveit et al. (2014) found a significant association between cervical pain and daily computer usage of more than two hours.

Three studies found associations between cervical pain and smartphone and tablet users (Berolo et al., 2011; Shan et al., 2013; Gustafsson et al., 2017) There was an association between high exposure (sending more than 20 messages per day) and cervical and upper extremity pain (Gustafsson et al., 2017) (OR=2.0). The researchers reported that 15- to 20-year-olds had the highest text messaging usage, thus, increased exposure lead to an association with cervical and upper extremity pain (Gustafsson et al., 2017); Shan et al. (2013) reported a significant increase in the prevalence of cervical pain with the use of mobile phones for more than two hours a day.

From the findings one could make the assumption that the difference in posture assumed during smartphone and tablet usage compared to posture during computer usage could be contributing to the associations with cervical pain. The other factor could be the higher level of exposure to IT and related postures leading to an association with cervical pain.

2.4.5 PSYCHOLOGICAL FACTORS

The fourth group of factors related to cervical pain in adolescents is psychological factors. This includes: emotional and mental health problems and the quality and quantity of sleep.

2.4.5.1 EMOTIONAL AND MENTAL HEALTH PROBLEMS

One contributing factor to cervical pain that has been extensively explored in literature relates to mental health problems. This includes emotional problems and factors such as stress (OR 1.68-6.14) (Feldman et al., 2002; Diepenmaat et al., 2006) depression (p=0.05) (Feldman et al., 2002; Diepenmaat et al., 2006; Shan et al., 2013; Myrtveit et al., 2014) and anxiety (p<0.001) (Jussila et al., 2014). Ten studies, done between 2002 and 2014, that assessed emotional and mental health problems, found a significant association with cervical pain (Feldman et al., 2002; Diepenmaat et al., 2006; El-Metwally et al., 2007b; Murphy et al., 2007; Mikkelsson et al., 2008; O'Sullivan et al., 2011a; Rees et al., 2011; Jussila et al., 2014; Myrtveit et al., 2014; Shan et al., 2013).

Contrary to the studies mentioned above, two studies found no significant association between mental health symptoms and cervical pain (Brink et al., 2009b; Brink et al., 2015). Depression and anxiety were measured with valid assessment tools such as the 21-Item Beck Depression Inventory and the 39-item Multidimensional Anxiety Scale for Children. However, the sample size of both studies were much smaller than those who found an association with cervical pain so one could, firstly, argue that that might have had an impact on the findings. Secondly, another significant difference between the studies that found no association between cervical pain and mental health issues and those that found an association was the countries where the studies were done. The negating studies were both done in South Africa (Brink et al., 2009b; Brink et al., 2015), a developing country compared to the other studies that were done in developed (first world) countries. A possible reason for the conflicting evidence is that learners in the developing country have different psychosocial exposures due to the different socioeconomic circumstances. In the developed countries good healthcare and social services are in place, supporting and referring people with mental health issues to relevant services. This might contribute to the perception of need for psychological help.

And finally, a reason for the conflicting evidence could be the type of study done by Brink et al. (2015). It was not a cross-sectional study but a prospective study to determine the effect of computers on pain-free learners. Only pain-free subjects were included in the study. One could question therefore, whether the sample group already excluded the learners with possible mental health problems.

According to the literature, the association between spinal pain and mental health problems can be present due to a number of reasons. The first possible reason could be pain sensitisation and changes in serotonin metabolism in the general population which may be contributed to an increase in spinal pain (Rees et al., 2011). Depression is a possible cause of too little serotonin and researchers argue that depression and stress could be the cause for cervical pain and not the consequence thereof (Mikkelsson et al., 1998; Diepenmaat et al., 2006).

The second possible reason is the specific postures adopted by adolescents suffering from mental health problems (Rees et al., 2011). These forward flexed postures do not differ much from slump posture, which is related to spinal pain due to the overload of joints (O'Sullivan et al., 2011b).

The third reason is the possible association between psycho-neuroendocrine and neurological development (Rees et al., 2011). Evidence suggests that due to central sensitisation of the nervous system, pain can be present with certain environmental stimuli and that could lead to functional limitations (Carter and Threlkeld, 2012). This could have a direct effect on spinal pain and mental health issues (Rees et al., 2011).

In conclusion, it is evident that mental health and emotional factors play a significant role in contributing to cervical pain in adolescents.

2.4.5.2 QUALITY AND QUANTITY OF SLEEP

There are several studies that explored the association of sleeping habits and cervical pain (El-Metwally et al., 2004; Mikkelsson et al., 2008; Ståhl, Kautiainen, El-Metwally, Häkkinen, Ylinen, Salminen et al., 2008; Auvinen et al., 2010; Paananen, Auvinen, Tammelin, Karppinen, Zitting, Taimela et al., 2010b, a; Palermo, Wilson, Lewandowski, Toliver-Sokol and Murray, 2011; Jussila et al., 2014; Andreucci, Campbell and Dunn, 2017).

The aspect of sleeping habits includes the average hours of sleeping (sleep quantity); sleep disturbances (sleep quality) and daytime tiredness. Sleep disturbances refer to difficulty falling asleep, nightmares and tiredness on waking up.

One study (Ståhl et al., 2008) found an association with cervical symptoms and quality of sleep. In contrast three studies (El-Metwally et al., 2007b; Mikkelsson et al., 2008; Auvinen et al., 2010) found no association with the quality of sleep.

Mixed results regarding association of quantity of sleep with cervical pain were found by Auvinen et al. (2010) and Jussila et al. (2014). Paananen et al. (2010a) found no association between quantity of sleep and cervical pain.

Two studies (El-Metwally et al., 2007b; Ståhl et al., 2008) found a significant association between cervical pain and daytime tiredness. Auvinen et al. (2010) found mixed results regarding daytime tiredness and cervical pain whereas Mikkelsson et al. (2008) found no association.

Possible hypotheses for the presence of musculoskeletal pain and the association with insufficient sleep include increased inflammation (due to cortisol and cytokine release) and the activation of the sympathetic nervous system (due to stress causing increased muscle tone) (Auvinen et al., 2010). The hypotheses appear therefore more related to the non-physical aspects of sleeping.

Two studies (Auvinen et al., 2010; Jussila et al., 2014) found that insufficient quality and quantity of sleep were associated with pain progression, thus leading to pain at a later stage. It was found that children reporting insufficient quality and quantity of sleep at age of 15 or 16 reported cervical and lower back pain two years later when they were aged 18 or 19 years respectively (Auvinen et al., 2010). Sleeping time was also associated with pain progression among 16-year-old boys (Jussila et al., 2014).

Palermo et al. (2011) found a strong association between chronic pain and sleep disturbances. This correlates with findings in an earlier study that daytime tiredness is associated with musculoskeletal pain (El-Metwally et al., 2007b).

In conclusion, there is mixed evidence for an association between cervical pain and sleeping habits. More evidence is present for quality of sleep having an influence on cervical pain with inconsistent evidence towards quantity of sleep. It appears that sleep disturbances have an association with the development of pain after two years.

2.4.6 DEMOGRAPHIC FACTORS

Socio-economic characteristics of the populations evaluated in the literature in the study include age, sex, income level of parents and education level of parents. Two possible contributing factors to cervical pain that are explored in the majority of studies are sex and age. These two factors are the last to be discussed in accordance with available literature.

2.4.6.1 SEX

The majority of studies on cervical pain in adolescents indicate that girls are more likely than boys to have cervical pain regardless the age of the girls (Diepenmaat et al., 2006; Auvinen et al., 2007; El-Metwally et al., 2007b; Haselgrove et al., 2008; Mikkelsson et al., 2008; Straker et al., 2009; Auvinen et al., 2010; Rees et al., 2011; Jussila et al., 2014; Myrtveit et al., 2014; Ruivo et al., 2014; Gustafsson et al., 2017).

Girls, aged 10 to 12 in Finland, had a 40% higher risk of developing musculoskeletal pain compared to boys (El-Metwally et al., 2007b). Three other studies done on adolescents, in Holland, Finland and China had similar findings with girls having more pain than boys (Diepenmaat et al., 2006; Auvinen et al., 2007; Shan et al., 2014).

There are three possible reasons why girls have more pain than boys. Firstly, girls have a decreased pressure pain threshold (Straker et al., 2011). The decreased pressure pain threshold could lead to increased symptoms with sustained positions where loading of the spine occur (Fillingim, King, Ribeiro-Dasilva, Rahim-Williams and Riley III, 2009). Secondly, girls and boys have different postures when it comes to sitting (Straker et al., 2009). Girls tend to sit more upright than boys with more cervical flexion when working at a desk so there is more stress on the cervical structures and faster muscle fatigue (if the stabilising muscles are not strong enough) (Poussa, Heliövaara, Seitsamo, Könönen, Hurmerinta and Nissinen, 2005; Straker et al., 2011). Thirdly, girls may be more willing to disclose pain and discomfort than boys, as seen in other studies (Ståhl, Mikkelsson, Kautiainen, Häkkinen, Ylinen and Salminen, 2004; Dianat et al., 2014; Myrtveit et al., 2014).

On the contrary, a South African study found that boys had a marginal majority of cervical pain (20.1% vs. 19.6% in girls) (Smith et al., 2009). Two studies conducted in India, found boys (40.2%; 3.28%) have more neck pain than girls (33.1%; 1.2%) (Panicker et al., 2014; Rai et al., 2014). It could be questioned whether the social environment and religious setting of the research populations in these studies explains why the boys had significantly more neck pain. To strengthen this possible explanation, a 2018 study done in Saudi Arabia (Alzaid, Alshadoukhi, Alnasian, Al Tuwairqi, Alotaibi and Aldossary, 2018), a country with a similar geographic position and social environment as India, found that boys also had a higher prevalence than girls. A total of 23.7% of participants had reportedly suffered from neck pain, 13.4%

boys and 10.3% girls. Mothers and aunts and not the learners themselves completed the questionnaires in the study. This could raise questions about the validity of the information considering social beliefs about sex and gender importance and recognition. As boys and men have more status and value than girls and women in countries like India and Saudi Arabia this could be a possible reason to the higher prevalence of pain in boys.

In conclusion, the majority of studies have shown that girls tend to have more cervical pain than boys. We can, however, not disregard boys in Asian countries. As part of gender it is important to consider social, cultural and biological influences on cervical pain and the perception thereof.

The last factor to have an effect on cervical pain in adolescents that will be discussed is age.

2.4.6.2 AGE

The effect of pain as adolescents get older has been investigated in several studies. The studies were done worldwide with large sample sizes ranging from 1073 participants to 3016 participants. Several studies have confirmed that prevalence of musculoskeletal and cervical pain increases with age (El-Metwally et al., 2004; Mikkelsson et al., 2008; Auvinen et al., 2010; Paananen et al., 2010b; Shan et al., 2013; Aartun et al., 2014; Jussila et al., 2014).

As most of the studies were cross-sectional studies there was no specific explanation given for the increase in cervical pain. Significant p-values were seen in two studies for the increase of cervical pain with age: $p<=0.05$ (Shan et al., 2013) and $p<0.001$ (Auvinen et al., 2010).

Only one study had conflicting information (Alzaid et al., 2018). The 7-11 year group of participants reported more pain than the 12- to14-year-old and 15- to 18-year-old groups. However, the study was investigating mobile phone use and the authors of the study argued that the prevalence of cervical pain was higher due to the stubbornness, difficulty in guiding and need for independence by the 7-11 year age group. Another reason for the difference in findings could be that mobile device use has significantly increased over the last few years, exposing younger age groups to risk factors in developing cervical pain (Müller et al. 2015). As seen previously in the literature study, the development of cervical pain is associated with the use of mobile phone and electronic tablets (Berolo et al., 2011; Shan et al., 2013; Gustafsson et al., 2017).

It is evident from the available literature that cervical pain increases with age in adolescents. It is however unclear what leads to the increase.

2.4.7 CONCLUSION

This section reviewed studies since the year 2002 with regards to factors contributing to cervical pain. It is evident from the literature that being female, increasing in age, depression, anxiety, insufficient sleep and perceived heaviness of schoolbags are related to cervical pain.

Sitting posture, exposure to information technology (IT), sleeping habits as well as schoolbag weight have also been explored. Conflicting results were found. From the literature it is clear that the perception of schoolbag weight as well as quality of sleep (also a subjective perception) was more closely related to the presence of cervical pain than the physical weight of the schoolbag or quantity of sleep. It was also evident that prolonged exposure to sitting and IT such as smartphones and electronic tablet devices can contribute to pain and discomfort.

It is evident from the literature that hypermobility is not an independent contributing factor to cervical pain.

The only dynamic assessments that were done, was posture assessment over a period of time (Breen et al. 2007; Brink et al. 2015). To the knowledge of the researcher no studies looked at dynamic control of the cervical spine or scapulae as possible contributors to cervical pain in adolescents, indicating a gap in the existing literature.

Dyskinesis, the lack of good movement control and position, has been assessed in adults. It is evident from the literature that dyskinesis of the scapula and cervical spine in adults contribute to cervical pain.

The next section of the literature study will review literature available on cervical and scapula dyskinesis.

2.5 DYSKINESIS OF THE CERVICAL SPINE AND SCAPULA

2.5.1 INTRODUCTION

A PubMed, Medline and Google Scholar search was done using the following key words: “neck control”, “cervical control”, “cervical dyskinesis”, “scapula dyskinesis”, “scapula control”, “neck pain” and “cervical pain”. Seven studies that assessed the scapula position or control and cervical pain were identified. Two studies were found assessing the cervical spine position and control and its relation to cervical pain. Four studies were identified analysing the effect of scapula dyskinesis correction on cervical pain.

The term dyskinesis is derived from the word dyskinesia and has widely been used in literature referring to poor shoulder (scapula-thoracic and glenohumeral) position and movement (Kibler and Sciascia, 2010). For the sake of this study dyskinesis will also refer to the cervical spine posture and control of movements.

Dyskinesis coincides with the theory of movement control as described initially by Shirley Sahrmann (2001) and later by Mark Comerford and Sarah Mottram (Comerford et al., 2012). Sahrmann (2001) found that faulty movement could induce pathology, not only be the result of it. In their textbook, Kinetic Control (Comerford et al., 2012), the authors elaborate how uncontrolled movements are linked to pain. The articular, myofascial and connective tissue systems have to work together to ensure good movement and control. According to Sahrmann (2001) scapular alignment is an indicator of possible changes in muscle length and joint position.

2.5.2 SCAPULA DYSKINESIS AND CERVICAL PAIN

The studies that focused on the relation between scapular dyskinesis and cervical pain are discussed first. This will be followed by a discussion of the treatment of cervical pain by addressing scapular dyskinesis.

Assessment of scapula dyskinesis and cervical pain

Several research studies in adults have focused on the relation between scapular dyskinesis and cervical pain (Castelein, Cools, Parlevliet and Cagnie, 2016; Cagnie et al., 2014; Zakharova-Luneva, Jull, Johnston and O'Leary, 2012; Helgadottir, Kristjansson, Einarsson, Karduna and Jonsson, 2011; HelgadoTTir et al., 2010). These studies have confirmed the relation between the presence of cervical pain and scapula dyskinesis in adults. The following associations between cervical pain and patterns of movement were derived from the literature.

Firstly, cervical and shoulder pain affect the orientation of the scapulae during shoulder elevation, suggesting altered dynamic stability is present at the scapulae. This then leads to the increased muscle activity in the levator scapulae and rhomboid muscles (axioscapular muscles) (Helgadottir et al., 2011). More activity in the upper fibres of trapezius with glenohumeral abduction and external rotation in patients with cervical pain is present than in the asymptomatic population (Zakharova-Luneva et al., 2012). The assumption is that the increased muscle activity in the axioscapular and upper trapezius muscles contribute to cervical pain but also to the presentation of scapula dyskinesis.

Secondly, altered muscle function of the scapula stabilisers exists in the presence of cervical pain (Castelein et al., 2015). Delayed onset of muscle activation of the serratus anterior and shorter duration of muscle activity of the serratus anterior was found (Helgadottir et al., 2011). This corresponds with findings in subjects with shoulder pathology and pain that also found delayed onset of muscle activation of the serratus anterior (Kibler et al., 2013). Poor serratus anterior control is present with scapula winging, a presentation of scapula dyskinesis (Kibler et al., 2010). Again, the evidence is that cervical pain potentially leads to scapula dyskinesis.

Thirdly, forward head and rounded shoulder posture in individuals without shoulder pain still show altered scapular kinematics with less serratus anterior activity as well as greater scapula internal rotation and upward rotation (Thigpen et al., 2010). The increased scapula internal rotation and upward rotation could be due to increased muscle activity in the rhomboid and levator scapulae muscles. This will have an effect on cervical spine muscle activity with increased pressure on the cervical spine levels one to four, where the levator scapulae muscle insert (Helgadottir et al., 2011). This could potentially lead to cervical pain.

Fourthly, computer professionals with cervical pain presented with significant differences in the scapula resting position compared to professionals without cervical pain (Dahiya and Ravindra, 2013). The resting position of the scapula was assessed in three different positions: arms at rest, hands on hips and arms in 90º glenohumeral abduction with internal rotation. All three positions showed significant differences. As the resting position is dependent on the muscle activity of the local stabilisers (serratus anterior, upper and lower fibres of the trapezius muscle) of the scapula (Kibler et al., 2010), the assumption can be made that there was insufficient activation of the local stabilisers, and this will lead to scapula dyskinesis.

From the above-mentioned studies it is clear that cervical pain has an effect on scapula position and movement. The scapula stabilisers had delayed activation and contraction with the scapula mobilisers having increased activity. The muscle dysfunction leads to poor scapula position and movement-scapula dyskinesis.

Although it does not seem to have been proven to lead to cervical pain it is clear from the above-mentioned studies that scapula dyskinesis could exist in the presence of cervical pain. Therefore it is important to review any possible studies that addressed scapula dyskinesis in the presence of cervical pain. A few studies were found that investigated the effect of scapula positional and movement correction on cervical pain.

Treatment of scapula dyskinesis and cervical pain

Four studies assessed the effect of scapular dyskinesis correction on cervical pain in adults (Andersen et al., 2014; Lluch, Arguisuelas, Calvente Quesada, Martínez Noguera, Peiró Puchades, Pérez Rodríguez et al., 2014; Desai et al., 2013; Ha, Kwon, Yi, Jeon and Lee, 2011). Three studies addressed the scapula position and one study addressed the scapular function. The outcome measure for all four studies was the effect on cervical pain.

Ha et al. (2011) (n=15 males) used a PCSPT (passive correction of the scapulae) apparatus to reposition downward rotated scapulae. All subjects presented with downward scapulae rotation (as seen in patients with poor posture or head forward posture of misaligned scapula positioning) and cervical pain of more than 5 on a visual analogue scale (VAS>5). A significant improvement in cervical range of motion and pain intensity was observed with the passive repositioning. This indicates that good scapula position contributes to optimal cervical function.

An intervention study (n=26) correcting the scapula position found that an immediate effect could be seen with increased cervical rotation (Desai et al., 2013). A physiotherapist encouraged scapula posterior tilting and external rotation with hand contact to correct the scapula position. There was an immediate change in the intensity of pain compared to the control group, again indicating that good scapula position has a positive effect on cervical pain.

Andersen et al. (2014) performed a randomised controlled trial (n=47) to assess the effect of scapular function training on chronic cervical or shoulder pain. Scapular function training was done using two exercises: a press-up and a push-up plus. The push-up plus exercise is similar to a plank exercise. Both exercises were used to activate the serratus anterior muscle and the lower fibres of the trapezius muscle without overusing the upper fibres of the trapezius. Self-rated cervical pain decreased significantly in the intervention group compared to the control group ($p<0.05$). As the scapula stabilisers recover in activation and endurance, the mobilising muscles such as the levator scapulae and the rhomboids are not needed and therefore decrease in activity. Firstly, the activation of the scapula stabilisers will lead to a better scapula resting position and movement but secondly, the improved position will have an effect on the mobilising muscle activity around the cervical spine.

The fourth study assessing scapular position compared active and passive scapula positioning for cervical pain (Lluch et al., 2014). Twenty-three (n=23) volunteers were recruited. Scapula repositioning was done in prone. The active group was asked to maintain a neutral scapula position while activating lower fibres of the trapezius muscle. The muscle contraction and scapula position was maintained for 10 seconds and repeated 10 times. Passive correction was done by passive repositioning of the scapula and maintaining of the position. No muscle activity was present during the passive intervention. Active re-positioning of the scapula was more effective for pain relief (Lluch et al., 2014). It is clear from the above-mentioned study that active scapula repositioning is superior to passive scapula positioning. One could argue this is due to the activation of lower fibres of the trapezius muscle, leading to decreased activity in the scapula mobilisers (the levator scapulae and rhomboid muscles) and the decrease in muscle activity around the cervical spine.

All four studies showed that the repositioning of the scapula and restoring of scapula muscle activation patterns had a positive effect on cervical pain. Scapula repositioning led to improved cervical range. One can reason that as the cervical spine and the scapulae are in a closed kinematic chain, the position of the one will have a direct effect on the rest of the kinematic chain. Therefore, correction of the scapula position led to the decrease of muscle activity around the cervical spine. Improved scapula position and control also provides a stable base for optimal function of the cervical spine. Improved muscle activation of the scapula stabilisers will lead to improved muscle patterns, which will in return lead to better positioning of the scapula and cervical spine.

2.5.3 CERVICAL DYSKINESIS AND CERVICAL PAIN

The studies that focused on the relation between cervical dyskinesis and cervical pain are discussed first. This will be followed by a discussion of the treatment of cervical pain by addressing cervical dyskinesis.

Assessment of cervical dyskinesis and cervical pain

Several studies investigated altered cervical alignment and change in patterns of muscle activation in adolescents (Brink et al., 2009a; Brink et al., 2009b; Hellstenius, 2009; Young, Trudeau, Odell, Marinelli and Dennerlein, 2012; Yoo, 2014; Brink et al., 2015; Oliveira and Silva, 2016; Xie et al., 2016).

Two studies in adolescents reported a vague correlation between lower cervical spine position and joint dysfunction and the presence of cervical pain (Brink et al., 2009b; Hellstenius, 2009). Another study (n=15) found an increase of head flexion angles with the use of media tablets (Young et al., 2012). In a more recent study by Brink et al. (2015) (n=153) a linear association between increased head flexion and an increased pain score in upper quadrant musculoskeletal pain was reported in adolescents. Three studies with a sample size of n=104, n= 153, n=70 respectively found that adolescents with cervical pain presented with significantly less forward head posture (Brink et al., 2009a; Brink et al., 2015; Oliveira et al., 2016). These adolescents with pain also presented with decreased cervical flexor and extensor endurance.

An increase of muscle activity in the upper trapezius and cervical erector spinae muscles were found in young people using touchscreen smartphones with chronic cervical-shoulder pain compared to the asymptomatic group (n=40; n=20 control, n=20 intervention) (Xie et al., 2016). Levator scapulae and the upper fibres of the trapezius muscle have an effect on the upper cervical flexion and cervical flexion angle, thus leading to altered biomechanics of the cervical area and contributing to cervical pain (Yoo, 2014).

Two studies that assessed the presence of cervical pain and altered cervical alignment, and patterns of activation in adults were identified in the existing literature. A correlation was found between cervical pain and cervical position and muscle activation (Falla et al., 2004; HelgadoTTir et al., 2010).

Limited studies addressing cervical dyskinesis in adults to reduce cervical pain were available (Harman, Hubley-Kozey and Butler, 2005; Gupta, Aggarwal, Gupta, Gupta and Gupta, 2013; Meisingset, Stensdotter, Woodhouse and Vasseljen, 2016; Wickstrom, Oakley and Harrison, 2017).

Harman et al. (2005) did a randomised control trial to investigate the effect of exercises on forward head posture (n=40; n=23 exercise group; n=17 control group). Exercises included pectoralis minor and cervical extensor muscle stretches as well as deep neck flexor and scapula retraction strengthening exercises. There was a significant change in the forward head posture of the intervention group. Unfortunately pain was not measured, so it is unclear if the exercises made any difference to the pain levels of participants.

In another randomised control trial, deep neck flexor exercises were compared to conventional cervical isometric exercises in a population of dentists with cervical pain (n=30; n=15 intervention, n=15 control group) (Gupta et al., 2013). Both intervention groups had an effect on neck pain but only the deep neck flexor training lead to a significant change in forward head posture.

A more recent longitudinal study showed minimal effect of conventional physiotherapy on motor control and joint position error (n=71, no control group) (Meisingset et al., 2016). The treatment consisted more of conventional therapy such as massage, joint mobilisations and dry needling. Even though individually supervised exercises were reported, it was not specified as to what was done.

A recent case study assessed the effect of postural correction and re-establishing of the cervical lordosis in a patient with acute cervical radiculopathy (Wickstrom et al., 2017). The patient received 40 sessions of therapy over a period of 17 weeks. Correction of posture, as part of physiotherapy intervention, led to pain and referred symptom relief. However, it is difficult to say how effective the treatment really was when taking into consideration the time frame (17 weeks) and the number of physiotherapy sessions (40 sessions) that lead to symptom relief. Expected healing and recovery from acute radiculopathy takes four to six months (16-24 weeks) (Iyer and Kim, 2016) so the case study continued only for as long as was the expected time of healing, not reducing the time.

There is a strong suggestion from the literature that postural cervical exercises may improve cervical posture but the evidence regarding pain relief through postural exercises is not clear. From the above literature it is difficult to draw any firm conclusions to the effect of cervical posture and dyskinesis correction on cervical pain.

2.5.4 CONCLUSION

Several studies confirmed the relationship between cervical pain and scapula dyskinesis in the adult population. It is evident from the literature that the correction of scapula dyskinesis, either by addressing the scapula position or function (stability control) led to a decrease in cervical pain. Good scapula position and function enables the cervical muscles to work from a stable basis as many cervical muscles are attached to the scapula. Good cervical muscle control ultimately leads to less strain on joints and muscles in the cervical spine, leading to a decrease in cervical pain.

A similar relationship between cervical pain and cervical dyskinesis was seen in studies assessing cervical position, function and pain in adults. From the literature available on the treatment of cervical pain it is seen that the correction and strengthening of cervical muscles had an effect on cervical posture and pain. Conventional physiotherapy treatment seemed to be less effective than stability exercises and postural correction.

From studies done in adolescents it can be seen that there is a linear relationship between forward head posture and cervical pain. Learners with cervical pain also presented with poor control and endurance of the cervical extensor muscles.

It is unclear if scapula and cervical dyskinesis is present in the adolescent population. In order to assess for possible dyskinesis it is important to firstly know what the ideal posture of the cervical spine is as well as the ideal resting position of the scapulae (See Glossary p xvi). Standard position and movement need to be assessed. Effective tests are necessary to determine the possibility of dyskinesis. The next section of the literature study will focus on the assessment of dyskinesis of the scapulae and cervical spine.

2.6 EVALUATION OF DYSKINESIS

There are several ways to assess dyskinesis as described in literature. In the Africa context it is vital to use a cost-effective method that is valid and reliable.

2.6.1 SCAPULA DYSKINESIS TEST

During assessment of scapula dyskinesis the aim is to determine if the learner can control the movement and position of the scapula (McClure, Tate, Kareha, Irwin and Zlupko, 2009). Several methods to assess Dynamic Scapula Position (DSP) have been described in the literature (Nijs, Roussel, Struyf, Mottram and Meeusen, 2007; McClure et al., 2009; Struyf et al., 2011; Habechian, Fornasari, Sacramento and Camargo, 2014). The aim is to assess scapula positioning during shoulder abduction and flexion. Studies have been done where surface Electromyography (EMG) was used to measure DSP (Struyf et al., 2011; Habechian et al., 2014). This method is limited to a laboratory environment and specialised equipment (Nijs et al., 2007).

Two relevant, valid and reliable tests to assess scapula dyskinesis were found in literature; the Scapula Dyskinesis Test (SDT) and the Kinetic Medial Rotation Test (KMRT). Both tests can be done in a clinical environment without using specialised equipment. The Kinetic Medial Rotation Test (KMRT) assessed the control of the scapula versus the humerus while the subject performs glenohumeral medial rotation in a supine position. As the test is performed in a supine position the scapula is in a stable position with proprioceptive feedback from the surface below the patient. The SDT is performed in standing. During the SDT the participant performs five repetitions of bilateral, active, weighted shoulder flexion and/or bilateral, active, weighted shoulder abduction. The test is done in a position with limited support or input to the scapula and scapula control can be observed during the test. The clinician observes the scapula for the quality of movement of the scapula, noting scapula winging, tipping and dysrhythmia. The scapula dyskinesis test was the preferred test for this study due to the fact that scapula control could easily be observed. The SDT has a validity of $p<0.001$ and odds ratio of 0.79 implying good reliability as found by authors McClure and Tate (McClure et al., 2009; Tate, McClure, Kareha, Irwin and Barbe, 2009).

The bony landmarks as described for the adult scapula position were used as reference points for the resting position of the scapula during the assessment of scapula dyskinesis. The aim was not to assess the scapula position in children as such but to use the described bony landmarks as reference points for the SDT. Nijs et al. (2007) reported the position of the adult scapula by combining available literature as follows:

- The scapula is at an angle of 30º in respect to the frontal plane (scapular plane).
- The medial border is positioned parallel to the spinous processes of the thoracic spine.
- The upper corner of the scapula should be positioned in line with T3.
- The inferior angle of the scapula should be in line with T7-9.
- The medial border and inferior angle should be positioned flat against the chest wall.
- The scapula should be positioned midway between medial rotation and lateral rotation as well as midway between elevation and depression.
- The left and right scapula should generally be symmetric although minor asymmetry could be present due to hand dominance (handedness posture with decrease elevation and further away from the spine).

2.6.2 OVERHEAD ARM LIFT TEST

Several tests to measure cervical position and control have been described in existing literature (Murphy et al., 2004; Harman et al., 2005; Brink et al., 2009b; Straker et al., 2009; Comerford et al., 2012; Brink et al., 2015; Oliveira et al., 2016; Ruivo, Pezarat-Correia and Carita, 2017). Most studies used photographic measurements of the cervical spine to determine abnormal cervical posture (forward head posture). Although the measurements were very reliable and valid it did not measure dynamic stability and control.

Isometric testing of the cervical flexor and extensor muscle endurance was done by Oliveira et al. (2016). Although the isometric tests were reliable, no testing of dynamic control of the cervical spine was done.

To test cervical dyskinesis an appropriate test was needed to assess dynamic control of the cervical spine. The cervical spine needed control while adjacent joints like the shoulder were moving. The principle of control with movement at different areas is called dissociation (Comerford et al., 2012). There were no valid or reliable tests found in the literature.

The overhead arm lift test (OALT) (Comerford et al., 2012) follows the principle of dissociation and control. The overhead arm lift test assesses lower cervical control and involves bilateral arm flexion while observing for lower cervical movement (dissociation). Although this test is not validated and reliability has not been tested it was designed on the basis of thorough research by Comerford et al. (2012) and is being used in clinical settings. The benefit of this test is that it is done in a standing position, as the scapula dyskinesis test, for which no special equipment is required in order to perform an accurate test.

2.6.3 VIDEO-BASED ASSESSMENTS

Video-based assessment allows for more detailed and reproducible observations which can be analysed using specific software and programs (Spielholz, Silverstein, Morgan, Checkoway and Kaufman, 2001). Validity and inter-rater reliability are also higher when using video-based observation (Xu, Chang, Faber, Kingma and Dennerlein, 2011). The benefit of the use of video recording is that it will limit the time of assessment, allowing for post-testing analysis. This will allow for more subjects to be tested in the limited time available.

2.7 SUMMARY OF THE LITERATURE REVIEW

Cervical pain is a common musculoskeletal condition affecting adolescents. In this chapter a literature background was provided to lay the foundation for the research study that has been done. Factors contributing to cervical pain were critically reviewed and discussed. As was observed in this chapter, many factors are contributing to cervical pain and have been investigated. Strong associations were found between age, sex, sleeping, bag weight, emotional and mental health factors. There was an association found between prolonged hours in sitting postures and cervical pain. Conflicting evidence was found in literature regarding posture and physical activities. No association was found between hypermobility and cervical pain.

There were no apparent studies that assessed dynamic control of the scapula and cervical spine with the presence of cervical pain in adolescents. The presence of cervical and scapula dyskinesis has been assessed in the adult population and the chosen method of dyskinesis assessment was discussed as well. It is evident that there is a gap in the existing literature with regard to scapula and cervical dyskinesis in adolescents. The relationship between scapula and cervical dyskinesis and cervical pain needs to be assessed to determine if there is an association.

Chapter 3 will now discuss the methodology of the study, focussing on the various tests and methods of execution.

CHAPTER THREE

3. METHODOLOGY

3.1 INTRODUCTION

In the previous two chapters the rationale for, and literature supporting the current study was discussed. This enables an understanding of the background and the motivation for the study. In Chapter 3 the methodology of the study will be discussed. The chapter outlines the study design, study setting, population and relevant objective tests that were used during data collection.

3.2 STUDY DESIGN

A quantitative, cross-sectional observational study design was used (Aldous, Rheeder and Esterhuizen, 2011).

3.3 STUDY SETTING

The study was conducted in four private schools in Tshwane, including Maragon Olympus Private School, Hatfield Christian School, Southdowns College and Curro Soshanguve. The four private schools were situated in different areas of Tshwane - one in the North, one in the South and two in the East. As Grade 7 is the beginning of high schooling in many private schools there was only one primary school involved and three high schools. It is assumed that the hours spent in class and doing homework is the same despite the year group being part of high school.

The data collection took take place in well-lit classrooms for three schools and in the school hall for the fourth school.

3.4 STUDY POPULATION AND SAMPLING

Study population

A total of 123 Grade 7 learners from the four different private schools in Tshwane participated in the study. The mean age of participants was 12.97 years, the start of adolescence. A detailed discussion on demographic information is provided in Chapter 4.

Sample size

A 95% confidence interval (CI) was required for the study. The required association was assessed using logistic regression. Sample size was determined by the number of events (E) (cervical pain) per (P) Variable (V) (e.g. demographic variables, determinants of risk and clinical variables). In particular EPV> 5 will determine sample size and for this study the number of events >4x5=20 (Peduzzi, Concato, Kemper, Holford and Feinstein, 1996). The expected prevalence of cervical pain is 20% (Smith et al., 2009). Thus, a sample of at least 100 children was required. However, to adjust for a possible design effect, as a result of clustering, a sample of at least 140 participants was aimed for. This was unfortunately not achieved due to the limited number of children who agreed to participate. However, 123 learners participated, a sample size above the minimum requirement.

Inclusion criteria

- Grade 7 learners at participating private schools in Tshwane;
- Learners had no major disabilities with regards to sight, mobility and intellect; and
- All learners are fluent in English language reading and writing.

Exclusion criteria

- Recent cervical and shoulder surgery- three months or less;

- Current therapy and/or intervention for cervical and/or shoulder pain; and
- Recent trauma and surgery of the cervical spine or shoulder are excluded as the normal healing process could still be in progress (Flanagan, 2000)

Sampling method

Convenient sampling was used to determine the study population. Ten English first language private schools in Tshwane were invited to participate in the study. Letters were sent to each school requesting the permission from the headmaster and school executive committee, where applicable. Permission was obtained from four of the private schools. Two schools declined the invitation and the other four schools did not respond to the letters of invitation.

Letters informing the parents and learners about the proposed study were given to all Grade 7 learners at the four private schools. The letters had attached consent forms for parents to complete (Annexure B). Assent forms (Annexure C) were given to the learners prior to the data collection.

Only learners with parental consent and who had given assent were considered for the study. The plan was to use a randomised sample of at least 40 learners (20 boys and 20 girls) per school but not enough learners gave consent to randomise the population per school. The sample sizes from the schools were respectively 22, 27, 32 and 38 and therefore all the learners who gave assent participated in the study.

3.5 PILOT STUDY

Pilot testing and peer review were done to ensure that the correct personal information was collected, and the pain questionnaire were understandable.

Pilot testing was done with three Grade 7 learners in a practice environment with informed consent and assent to determine the video camera set-up and ensure that the marking of anatomical landmarks was correct.

One-kilogram weights were used during the scapula dyskinesis test and trick movements were found. The weights were reduced to 300g weights. The 300g weights seemed to load the glenohumeral joint sufficiently without any trick movements.

The marking of the anatomical landmarks were more effective in the female participants using stickers for T3 and T8 instead of body markers.

The questionnaires seemed to be fully understood as questions were answered correctly and no uncertainties arose. Therefore no changes were required to the questionnaires. None of the results from the pilot study was included in the study data.

3.6 DATA COLLECTION

Data collection in schools took place in October and November 2016. Dates were chosen to accommodate the diaries of each individual school. The data collection took place during school hours. Permission was obtained from the headmasters and school governing bodies of all four schools. Each school appointed a coordinator to manage the logistics of the data collection. Care was taken to ensure the least amount of disruption to class time.

The primary researcher, a physiotherapist, headed up a team of four qualified physiotherapists. Researcher A (primary researcher) has more than 15 years of clinical experience in musculoskeletal physiotherapy, with a post-graduate diploma in Orthopaedic Manual Therapy, and is involved with student clinical supervision at the Physiotherapy Department at the University of Pretoria. Researchers B, C and D (research assistants) all have more than 10 years of clinical work experience, post-graduate diplomas in Orthopaedic Manual

Therapy and are registered with the Health Professions Council of South Africa (HPCSA).

Researcher B was assisting researcher A with the data collection and video recordings of movement tests of the participating learners. Physiotherapy students from the University of Pretoria and two qualified physiotherapists assisted with ad-hoc logistics during the data collection.

During the data collection researcher A explained the procedure and movement tests to all the participating learners. Thereby all the participants received the same commands and explanation.

Researchers C and D were not involved during data collection but assisted in post-collection analysis of the movement tests. Researchers A, C and D analysed the movement tests together and a single result was given to each participant for every test.

A video camera (JVC Everio S GZ-MS215) was used to record the scapula dyskinesis and overhead arm lift tests. The video camera was attached to a tripod that was positioned on the floor. The subjects stood 2-3 meters away from the camera, depending on their height. The positioning and areas recorded will be discussed more comprehensively with each separate measurement tool.

<u>Measurement tools</u>

A combination of questionnaires and clinical tests were used during the data collection. See Table 1 for a complete list and full outline of the tools used.

Table 3.1: Methodology according to aims, measurement tools used and the validity and reliability of the tools used.

RESEARCH AIMS	METHODS	MEASURE-MENT TOOLS	AIMS of TOOL	SOURCES OF TOOL CONTENT	VALIDITY AND RELIABILITY
1. To	Question-	Adapted young	To	Face validation	

determine the prevalence of cervical pain in the Grade 7 study population.	naire	Spine Questionnaire	determine the presence of pain in the cervical and shoulder area.	Preliminary reliability (Aartun et al., 2014; Lauridsen and Hestbaek, 2013). Awaiting full validation but no further literature available.	
2. To determine the prevalence of cervical dyskinesis in the study population.	Physical assessment	Plumb line measurement in standing	To evaluate posture (position).	(Kendall, McCreary and Provance, 1993; Hickey, Rondeau, Corrente, Abysalh and Seymour, 2000) ICC= 0.830, 0.846 intra-tester reliability ICC= 0.738, 0.781 inter-tester reliability	
	Physical assessment	Overhead arm lift test	To evaluate lower cervical control during arm movements.	(Comerford et al., 2012) Kinetic Control® developed test.	Face validation done by two peers.
3. To determine the prevalence of scapular dyskinesis in the study population.	Physical assessment	Evaluation of resting scapula positioning	To evaluate the resting position of the scapula on the thoracic wall.	(Lewis, Green, Reichard and Wright, 2002; Nijs et al., 2007; T'Jonck, Lysens and Grasse, 1996) Validity ($p<0.005$) Reliability of ICC 0.88	
	Physical assessment	Scapula dyskinesis test	To evaluate scapula dynamic movement and control.	(McClure et al., 2009; Tate et al., 2009)	Validity $p<0.001$. Reliability odds ratio of 0.79**)**

<u>Measurement methods / technique</u>

On the day of assessment each learner was given a unique participation number. The girls all wore grey shoestring tops provided by the researcher to ensure adequate covering of their chests but exposure of their scapulae. The boys were only wearing sports shorts. The learners changed in the store rooms of the classes or in bathrooms to ensure privacy of the learners.

Their names were only captured on the parental consent and assent forms. A unique number was used on the mark sheet and questionnaires the participants had to complete. The number was written with face paint pens on the participants' right deltoid and right scapula for identification during data analysis.

This ensured that the questionnaires and objective tests marking sheets of the participants were paired and the data was analysed concurrently. This also ensured that the assessment forms remained unidentifiable to the researchers and any staff at the schools and university, thereby guaranteeing confidentiality.

The learners all received a questionnaire in the form of a booklet (Annexure D). The content included a personal information form followed by die Adapted Young Spine Questionnaire. Participants were asked to complete both forms before the commencement of the physical tests. The researcher was present during the completion of the personal information and Adapted Young Spine Questionnaire to answer questions from the participants to ensure that reliable data was collected. After completing the questionnaires the booklet was given to the researchers. In the booklet the mark-up for the physical tests were included to ensure that the collected data for each learner was held together.

Personal information

This was a self-developed information form that included specific questions about the participant's general health, school and extramural activities as well as the use of computers or any other IT (e.g. electronic tablets and game consoles). A few specific questions, obtained from previous literature, were included that addressed certain independent factors that can cause neck pain. The factors addressed were: sex (gender), prolonged periods of sitting, the use of IT and the perceived schoolbag weight. (See Annexure D).

Adapted Young Spine Questionnaire (Lauridsen et al., 2013)

The Young Spine Questionnaire is a questionnaire that assesses pain in the spine. For each area namely the cervical, thoracic and lumbar spine, the area is marked on a body chart to ensure the correct area is assessed. Pain intensity is marked on a numeric scale. The influence of pain on activity as well as a family history of pain is also assessed.

The Young Spine questionnaire was adapted by only assessing pain in the cervical area and the glenohumeral joint (shoulder). Glenohumeral pain was assessed in the same way as the cervical pain with a body chart indicating the relevant area. A numeric pain scale was used with questions about the influence of pain on activity and family history.

The thoracic and lumbar spine areas were not assessed even though it is part of the Young Spine Questionnaire, as it is not relevant to the current study. (Annexure D).

Physical tests

The following physical tests were used to determine the resting position as well as dynamic position and control of the cervical spine and scapula: posture analysis that includes plumb line posture and the resting position of the scapula, the scapula dyskinesis test (SDT) and the overhead arm lift test (OALT). Information gained from these tests gave an indication of the ability of the cervical spine and scapula stabilisers to position and control the cervical spine and scapula during movement.

All tests were conducted in the same order for all participants. This was to ensure that the muscle exposure during the active tests was the same and to prevent discrepancies during measurements.

The physical tests were done in a classroom in three schools and a school hall in the fourth school. The following preparation was done to ensure the best conditions for video recording.

Table 3.2: Preparation for physical tests

Class room:	Participants:
Well-lit	Girls dressed in shorts and a gym top. Gym top was provided.
Video camera positioned with light from behind	Boys dressed in shorts, no shirts.

Video camera facing light wall, no window to prevent glaring	Body marker used to write participant number on right upper arm and scapula.
Station 1: photography of posture with X marked on floor	Body marker used to mark anatomical landmarks before evaluation.
Station 2: video recording with X marked on floor	Participants wore a mask to ensure no identification on recordings.

POSTURE ANALYSIS

a. Plumb line measurement procedure

Posture was evaluated according to the plumb line measurement procedure (Kendall et al., 1993). The point of reference for the plumb line was the base of the foot - slightly anterior to the lateral malleolus.

Table 3.3: Reference marks and interpretation of ideal posture (Kendall et al., 1993)

Head	Head position neutral, not tilted forwards or back
Cervical spine	Normal curvature, slightly convex anteriorly
Scapulae	Flat against the thoracic chest wall
Thoracic spine	Normal curve, slightly convex posterior
Lumbar spine	Normal curve, slightly convex anterior
Pelvis	Neutral position, ASIS in line with symphysis pubis
Hip joints	Neutral position
Knee joints	Neutral position
Ankle joints	Neutral position - leg vertical and at right angle to sole of foot

Figure 3.1: Lateral view of posture analysis

The plumb line posture and deviations of each participant were recorded on the mark sheet provided for post-collection data analysis. Normal posture was noted if posture was in alignment with the plumb line. Any visible deviations were marked as abnormal. See Annexure E *b. Resting scapula position*

The ideal adult resting position of the scapula as described by Nijs et al. (2007) was used for the study. Markers of the adult scapula position were not used to analyse the resting position as such but to ease the analysis of scapula dyskinesis.

Figure 3.2: Posterior view of scapula resting position

The following landmarks were marked with a skin pencil for analysis of the resting scapula position:
-The spinous processes of the following thoracic vertebrae: third (T3), fourth (T4), eighth (T8)
-The superior angle of the scapula
-The root of the spine of the scapula
-The inferior angle of the scapula
(These were used to evaluate the position of the scapula as it is positioned on the thoracic wall at rest.)

The ideal resting position of the scapula in adults is summarised in Table 4.

Table 3.4: Ideal resting position of the scapula (Nijs et al. 2007)

Scapula landmark	**Ideal position**
Root of scapula spine	Level to T3 projecting to T4
Inferior angle relation to superior angle	Inferior angle should be lateral to superior angle
Medial border position	Parallel to thoracic spine
Inferior angle	Against thoracic wall in line with T7-9
Position of the spine of the scapula	Angled upwards

While at ease the scapula was observed for the following deviations:
-Scapula tipping: inferior angle prominence
-Scapula winging: medial border winging (more than two-thirds of the medial border)

-Pseudo winging: inferior third medial border winging
-Symmetry of the scapulae

The resting position of the scapula was recorded on the mark sheet of post-data collection analysis. See Annexure D.

SCAPULA DYSKINESIS TEST

Dynamic scapular stability was assessed with the Scapular Dyskinesis Test (SDT) (McClure et al., 2009; Tate et al., 2009). The aim was to assess the dynamic position and control of the scapulae while doing glenohumeral abduction.

Figure 3.3: Scapula dyskinesis test

Starting position:
-The participant stood at ease with 300g weights in both hands.
-The participant faced away from the video camera.
-The test started with arms by side, elbows extended and shoulders in external rotation (thumbs facing sideways).

Instructions before procedure:
The participant was instructed to lift the arms through the full range of abduction for three counts and to lower the hands back to the starting position for three counts. The primary researcher counted for all learners. Five repetitions were done. The participant was allowed to practice each movement without the weights.

Test procedure:
Five repetitions of full range of motion active glenohumeral abduction were done to assess for scapula dyskinesis. Weights of 300g were used as recommended by McClure et al. (2009).

Only the fifth repetition of abduction was used for data recording. This was to ensure that the learner uses his/her own unique movement pattern to notice any abnormality in scapulohumeral rhythm as written up by McClure et al. (2009) and Tate et al. (2009).

The researcher was observing the movement of the scapula for tipping (inferior angle prominence), winging (medial border winging - more than two-thirds of the medial border), dysrhythmia (premature or excessive elevation/protraction or a non-smooth motion of scapula) and symmetry (no dyskinesis).

The observations were recorded on the mark sheet for post-data collection analysis (Annexure D). Any tipping, winging or dysrhythmia was documented as dyskinesis.

OVERHEAD ARM LIFT TEST

Lower cervical stability was assessed with the Overhead Arm Lift test (OALT) (Comerford et al., 2012). This is a dissociation test to assess the ability to actively dissociate and control low cervical flexion while moving the shoulders through overhead flexion.

Starting position

- The participant stood with arms by side thumbs facing forward.
- The scapula cervical spine was positioned in neutral by the therapist. The plane of the head had to be vertical.
- The participant's body was facing posterolateral for optimal video recording of movements.

Figure 3.4: Overhead arm lift test

Instructions before procedure

The participant was instructed to lift both arms up for a count of three seconds and lower the arms down for a count of three seconds. The participant was instructed to not move his/her head or cervical area while lifting his/her arms.

Test procedure

The participant was assessed doing active shoulder overhead flexion/elevation while controlling the low cervical spine and keeping the head neutral. Five repetitions of bilateral active shoulder flexion were done.

Only the fifth repetition was used to observe control during movement. Five repetitions were done to allow fatigue to interject and to rule out any compensation or muscle weakness (Comerford et al., 2012).

The researcher observed for a greater movement into flexion in the low cervical region compared to the shoulder girdle with arm flexion. The researcher also observed for an attempt to correct the lower cervical flexion by using too much effort (fixating) or not succeeding at all to control the cervical movement.

Documentation:

Aspects observed during the test included the ability to dissociate between cervical and shoulder movement, breathing patterns and control during the movement. The observations were recorded on the mark sheet for post-data collection analysis. See Annexure D

Quality control

Every participant performed all tests in the same order. The main researcher counted for the participants with both the scapula dyskinesis and overhead arm lift tests.

Video recording allows for more detailed and reproducible observations which can be analysed by all three researchers. The use of video recording will thus increase the validity and reliability of observation of the physical tests.

3.7 ETHICAL CONSIDERATIONS

The study was conducted in accordance to the ethical principles of the Declaration of Helsinki.

Approval for the research was obtained from the School of Health Care Sciences and the Faculty of Health Sciences Research and Ethical Committee (ethics approval number 275/2016). (Annexure E) The requirements of the Faculty of Health Sciences Research and Ethical Committee were adhered to during the entire research process.

Submissions of the request to conduct research to various schools were done in August and September 2016. Written permission was obtained from the headmasters and/or school governing bodies of invited schools. See Annexure F.

Only learners with written parental consent and who had given written informed assent were included in the study. See Annexures B and C for relevant forms. Learners were informed that they had the right to withdraw from the study at any time, with no consequences to themselves.

Confidentiality of the students was ensured as follows:

- The assent forms were marked with numbers 1-123. The numbers were written on the mark sheets and the mark sheets were kept separate from the assent forms to ensure that the learners' names were kept confidential.
- All information gathered from the subjects was kept confidential and in a safe place. The video recordings were saved on two removable hardware discs. No recordings were saved on any laptop, computer,

tablet or phone to prevent access through the Internet or with computer hacking of recordings.

- The removable hardware discs were stored in two separate secured places in the Physiotherapy Department at the University of Pretoria. The information will only be used for research purposes.
- The parental consent and assent documents with participant names and contact details were stored in a separate secure place to ensure privacy and confidentiality.

As this was an observational study no harm was brought about by the study.

3.8 FEEDBACK

Feedback of the findings of the study was given to all the Grade 7 learners and teachers at the relevant schools.

A slideshow presentation was used and the presentation included information on the prevalence of cervical pain as well as contributing factors (Annexure G). It also included general advice on posture and ergonomics, activities to prevent cervical pain and exercises to improve scapula and cervical strength and control. The slideshow was done within 6 weeks of the data collection at each of the participating schools.

Each learner received an information and exercise leaflet to remind them of the exercises and sitting posture. See Annexure H for a sample of the information leaflet.

3.9 DATA MANAGEMENT AND ANALYSIS

Post-data collection analysis of the movement tests was done by researchers A, C and D. The three researchers analysed the data collectively as a team. The videos were assessed together at the primary researcher's home, and the outcome of the tests was discussed if the researchers did not agree. In the end each test had only one outcome.

Coding was done to assign a number to each outcome. ‘Yes’ was assigned a one (1) and ‘no’ assigned a zero (0). Excel sheets were used to do the coding and data was analysed according to the coding.

3.10 SUMMARY

In Chapter 3 a comprehensive outline of the methodology is given. The study design, study setting and study population was highlighted. The data collection was discussed in detail to clearly explain the method used by the researcher. To conclude, ethical considerations and data management were addressed.

In Chapter 4, the results from the data collection will be discussed and analysed according to the aims and objectives stipulated in Chapter 1.

CHAPTER FOUR

4. RESULTS

4.1 INTRODUCTION

In this Chapter, the results will be analysed and interpreted. The results pertain to the research questions that guided the study. Data was obtained from the personal information questionnaire, the Adapted Young Spine Questionnaire, the Scapula Dyskinesis Test (SDT) and the Overhead Arm Lift Test (OALT). A total of 123 learners were evaluated. In some cases data was missing, which was mainly due to learners not completing the questionnaires thoroughly. The data will be presented as follows:

- Firstly, demographic information will be presented. This will include health related issues.
- Secondly, the presence of cervical pain will be analysed and interpreted.
- Thirdly, the risk factors related to cervical pain in adolescents will be described. These risk factors include perceived schoolbag weight, seated educational and recreational activities, information technology usage for education and recreation, and sport and extramural participation.
- Fourthly, the presence of scapula and cervical dyskinesis will be presented.
- Finally, the association between cervical pain and scapula and cervical dyskinesis as well as the association between cervical pain and the identified risk factors will be analysed.

4.2 METHODS OF DATA ANALYSIS

Descriptive statistics was used to determine mean, standard deviation, frequency, proportion and cross tables. The primary objective (the association between cervical pain and scapula and cervical dyskinesis) was assessed using a multivariable logistic regression analysis. Of particular importance will be the adjusted odds ratios (OR), along with 95% confidence interval (CI) for cervical and scapula dyskinesis. The level of significance was set at 0.05.

4.3 GENERAL DEMOGRAPHIC INFORMATION

Four private schools in Tshwane participated in the study. The schools were located in Olympus, Waterkloof Glen, Centurion and Soshanguve. Participation was voluntary. The target sample size was 100 learners to obtain a 95% confidence interval (CI) and detect significant changes.

The data collected from schools were not compared but grouped together for comprehensive data analyses and interpretation.

4.3.1 <u>School And Learner Distribution</u>

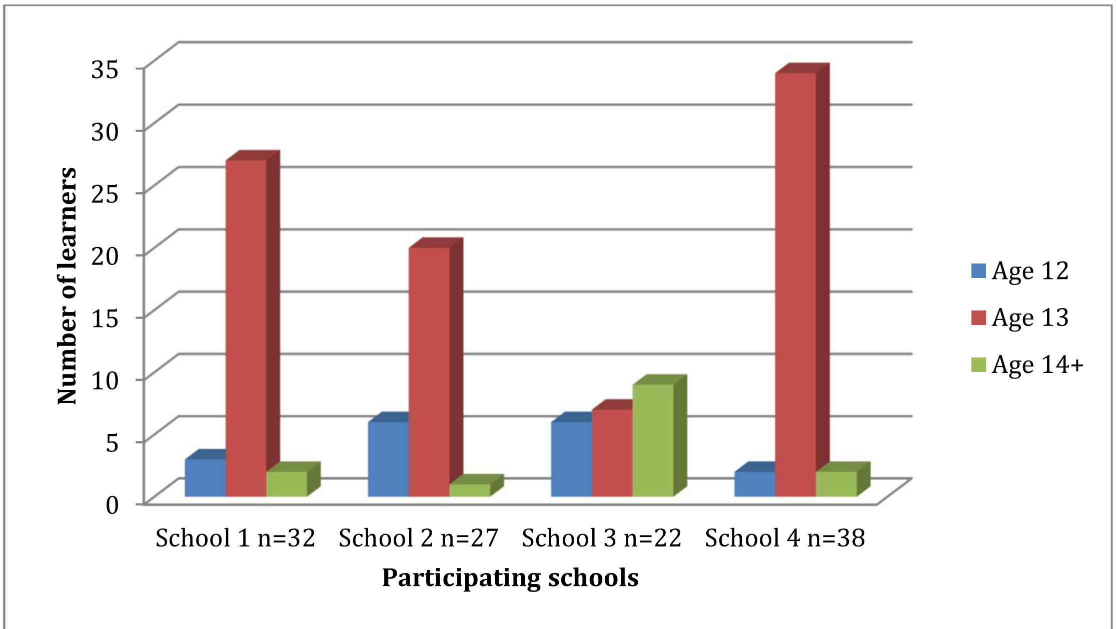


Figure 4.1: School and learner distribution according to age

In Figure 4.1 the school and learner distribution according to age are shown. The X-axis represents the schools, subdivided into age groups. The Y-axis represents the number of participants that completed the questionnaires. The blue bar on the graph represents the responses from the learners that are 12 years old. The red bar represents the responses from the learners that are 13 years old. The green bar represents the responses from the learners that are 14 years or older.

A total of 77 girls and 46 boys participated in the study (n=123). The mean age of the study was 12.97 years. Four (4) participants did not disclose their age.

In Table 4.1 below the demographic information of the learners are presented. The columns represent the total number of learners presenting with the characteristics and the percentage of learners with the characteristics. The rows represent the different characteristics as assessed during data collection.

Table 4.1: Demographic information of learners

Characteristics		**Total (n)**		**Percentage (%)**		
		Boys	**Girls**	**Total**	**Boys**	**Girls**
Sex		46	77	**100%**	37%	63%
Schools	**Maragon Olympus**	12	21	**27%**	36%	64%
	Southdowns College	4	23	**22%**	15%	85%
	Curro Soshanguve	12	13	**20%**	48%	52%
	Hatfield Christian School	18	20	**31%**	53%	47%
General health problems		12	20	**27%**	37%	63%
Prescribed medicine		11	20	**25%**	35%	65%
Previous surgery		25	19	**44%**	57%	43%
Allergies		9	32	**33%**	22%	78%
Headaches		8	17	**20%**	32%	68%
Previous neck or shoulder injuries		21	20	**33%**	51%	49%
Previous neck or shoulder surgery		0	0	**0%**	0%	0%

4.3.2 Health Information

Health related information (Table 4.1) was obtained through the following questions regarding health problems: medication, surgery, allergies, headaches and previous neck and shoulder injuries. Headaches is one of the factors related to cervical pain, therefore the information on headaches was analysed separately.

A total of 27% (n=32) of the learners reported general health problems. The health problems varied between Attention Deficit Hyperactivity Disorder (ADHD), asthma, hypothyroidism, as well as orthopaedic problems.

A total of 25% (n= 31) of the learners reported that they use regular prescribed medication. The medications include inhalers for asthma, anti-histamines, Concerta and Ritalin (26%), and depression medication. One learner reported the use of painkillers at the time of assessment.

A total of 44 (36%) of the learners had surgery in the past. Previous surgeries reported included tonsillectomies (34% of reported surgeries), insertion of grommets surgery and surgical intervention for fractures of lower and upper limbs.

A total of 33% (n=41) of learners reported an allergy. Specifically 24% of learners with allergies reported food allergies. A higher percentage (29%) of learners reported environmental allergies.

A total of 33% (n=41) of learners reported that they have injured their neck and/or shoulders in the past. Injuries were predominantly sports-related (11%, n=14). None of the participants reported that they had neck or shoulder surgery after these injuries.

4.3.3 <u>Headaches</u>

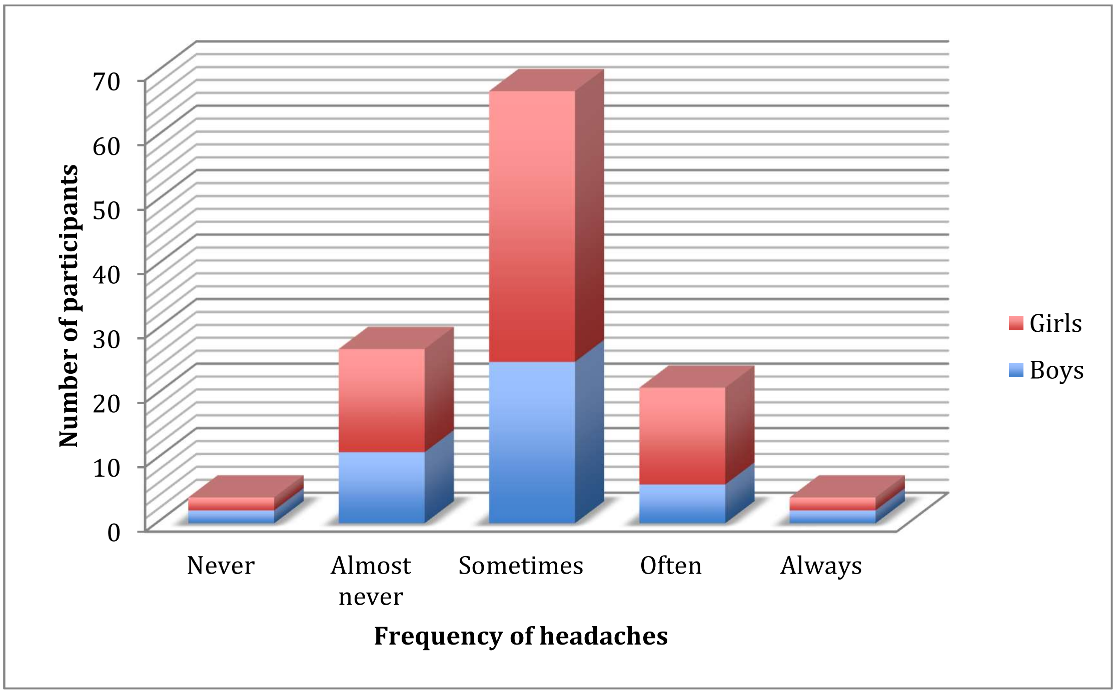


Figure 4.2: The reported frequency of headaches

In Figure 4.2 the frequency of headaches are shown. The X-axis represents the Likert scale options 'never', 'almost never', 'sometimes', 'often' and 'always'. The Y-axis represents the number of participants that completed the question. The red bar on the graph represents the responses from the girls and the blue bar represents the responses from the boys.

A Likert scale was used to report headaches. The learners were offered five possible responses to choose from. The responses were grouped together as either regular or irregular. Responses grouped together as regular were for the selection of either 'often' or 'always' on the Likert scale. The grouping was decided on according to how regular the symptoms were - if it was unusual to get the symptoms then it was classified as irregular. Responses group together as irregular was for the selection of either 'never', 'almost never' or 'sometimes'. A total of 20% (n=25) of learners reported experiencing headaches often or always (regular grouping).

4.4 PRESENCE OF CERVICAL PAIN

Cervical pain was reported in three different time periods: on the day of assessment, in the previous week and in the previous three months. The frequency (number of occurrences in the last three months) of cervical pain was also determined. Descriptive statistics (percentage of pain reported and odds ratio) were used to describe the presence of cervical pain in all three time periods and frequency. Logistic regression analysis was used to determine the likelihood for persistent cervical pain and the Fischer test (p-value) was used to analyse the differences between the boys and girls with regards to the frequency of cervical pain.

4.4.1 Cervical Pain Over Different Time Periods

A total of 21.31% (n=26/122) of all learners reported cervical pain on the day of data collection, with 36.07% (n=44/122) of all learners reporting pain in the last week and 51.64% (n=63/122) of all learners reporting pain in the last three months.

A total of 77% of participants (n=20/26) who presented with pain on the day of assessment reported pain in the previous three-month period (odds ratio=0.77). This implies that 77% of all the learners who had pain on the day of assessment also had pain in the previous three months.

4.4.2 <u>Cervical Pain Frequency</u>

Cervical pain frequency was evaluated on a Likert scale and learners were offered the option ‘never’, ‘once or twice’, ‘once in a while’ and ‘often’.

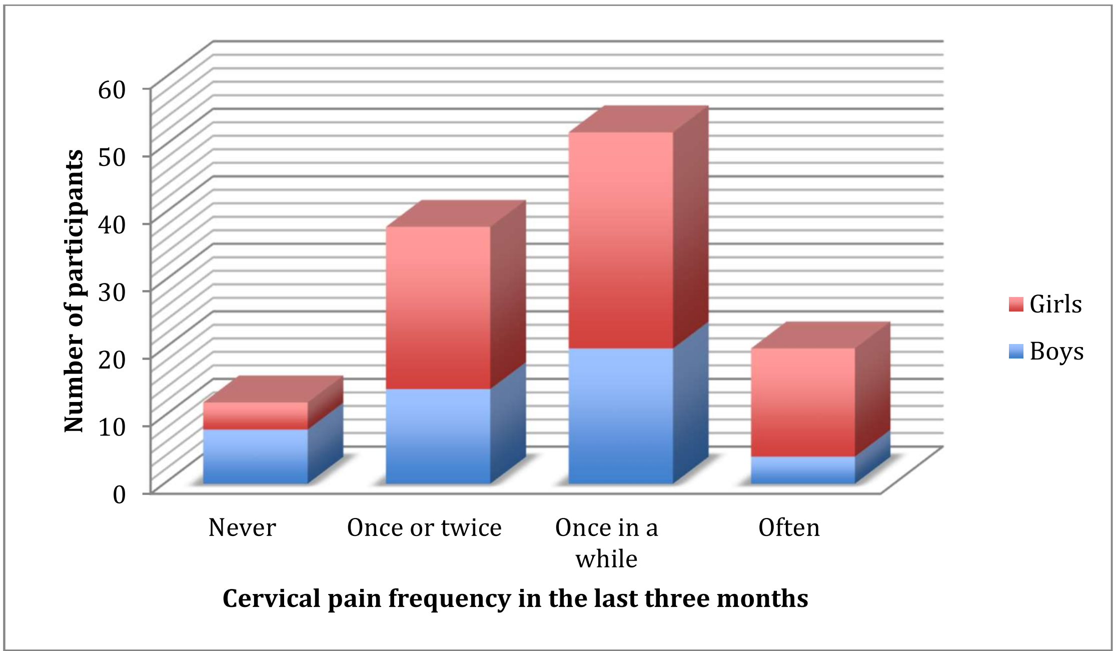


Figure 4.3: Cervical pain frequency in the last three months

In Figure 4.3 the frequency of cervical pain is shown. The X-axis represents the Likert scale options ‘never’, ‘once or twice’, ‘once in a while’ or ‘often’. The Y-axis represents the number of participants that completed the question. The red bar on the graph represents the responses from the girls and the blue bar represents the responses from the boys.

Participants were asked to indicate how often they experienced pain in the cervical region. Girls reported more often than the boys, but only marginally (p=0.08). The categories ‘never’, ‘one or twice’ and ‘once in a while' were classified under irregular whereas the category ‘often’ was classified as regular. The regular group was then compared to the irregular group. A total of 16% (n=20/122) of learners reported that they experienced pain regularly (p=0.084).

4.5 RISK FACTORS RELATED TO CERVICAL PAIN

Descriptive statistics were used to describe the presence of potential risk factors. The Fischer's exact test was used to analyse the risk factors with cervical pain. Statistically significant differences are reported with p</=0.05.

Risk factors were evaluated in terms of frequency and duration. All the risk factors were evaluated on a Likert scale. The responses were grouped together into regular or irregular. Responses were grouped together as regular for the options 'often' or 'always'. Responses were group together as irregular for the options 'never', 'almost never' or 'sometimes'. When frequency was assessed, the Likert scale had four possible responses; 'once a week', '2-3 times a week', '4-5 times a week' and '6-7 times a week'. The responses were grouped together as regular ('4-5 times a week' or '6-7 times a week') and irregular ('once a week' or '2-3 times a week'). Duration was assessed with four possible responses to choose from. The responses were once again grouped into regular and irregular. Responses grouped together as irregular were the options 'less than 1 hour', '1-2 hours' and '3-4 hours'. The '4-5 hours' option was the only response that represented the regular group.

In Table 4.2 risk factors related to cervical pain in the learners are presented. The columns represent the total number of answers, the total number of learners presenting with the risk factor grouped into regular and irregular and the p-value for the differences between girls and boys. The rows represent the different risk factors as assessed during the data collection.

Table 4.2: Risk factors related to cervical pain

		Total number of Answers	Regular		Irregular		p-value
			Boys	Girls	Boys	Girls	
Headaches		123	8	17	38	60	0.803
Perceived schoolbag weight		117	19	49	22	27	**0.021**
Educational seated activities							
Homework	Frequency	123	30	66	16	11	**0.001**
	Duration	122	12	23	34	53	0.548
IT usage at school	Frequency	122	11	20	35	56	0.781
	Duration	106	11	18	26	51	0.950
IT homework	Frequency	122	12	16	34	60	0.237
	Duration	114	4	17	36	57	0.087
Recreational seated activities							
Reading	Frequency	122	9	20	36	57	0.301
	Duration	106	5	11	35	55	0.587
Recreational IT devices	Frequency	119	21	27	25	46	**0.026**
	Duration	106	7	6	37	56	0.617
TV games	Frequency	117	8	1	36	72	**0.000**
	Duration	75	10	4	28	33	0.067
Phone usage	Frequency	119	45	70	0	4	0.296
	Duration	113	9	24	36	44	0.393
Other activities							
Sport	Frequency	112	21	24	23	42	0.347
	Duration	112	9	13	36	54	1.000
Extramural activities	Frequency	74	3	15	19	37	0.337
	Duration	74	1	6	21	46	0.138

The risk factors related to cervical pain are now analysed and interpreted. The first factor presented is perceived schoolbag weight.

4.5.1 Perceived Schoolbag Weight

Six of the learners (n=6) did not complete the question. More than 58% (n=68/117) of the learners reported regular bag heaviness and perceived their schoolbag's weight 'often' or 'always' as too heavy. Girls were statistically more likely to experience their schoolbags as too heavy (p=0.021).

4.5.2 Educational Seated Activities (Schoolwork And Homework)

Educational sitting activities were explored in several ways. Firstly, the participants were asked about school hours and length of classes. This was to determine if all the participants had the same exposure to sitting activities at their respective schools.

Secondly, time spent on homework was explored. This included frequency and time spent doing homework.

4.5.2.1 School Hours

School hours for the participants varied between six hours 10 minutes and six hours 30 minutes. Class periods varied between 40-50 and 50-60 minutes per class. There was no statistically significant difference between the hours spent at school for the learners (p=0.276), therefore the school activities can be pooled together and compared.

4.5.2.2 Homework Frequency

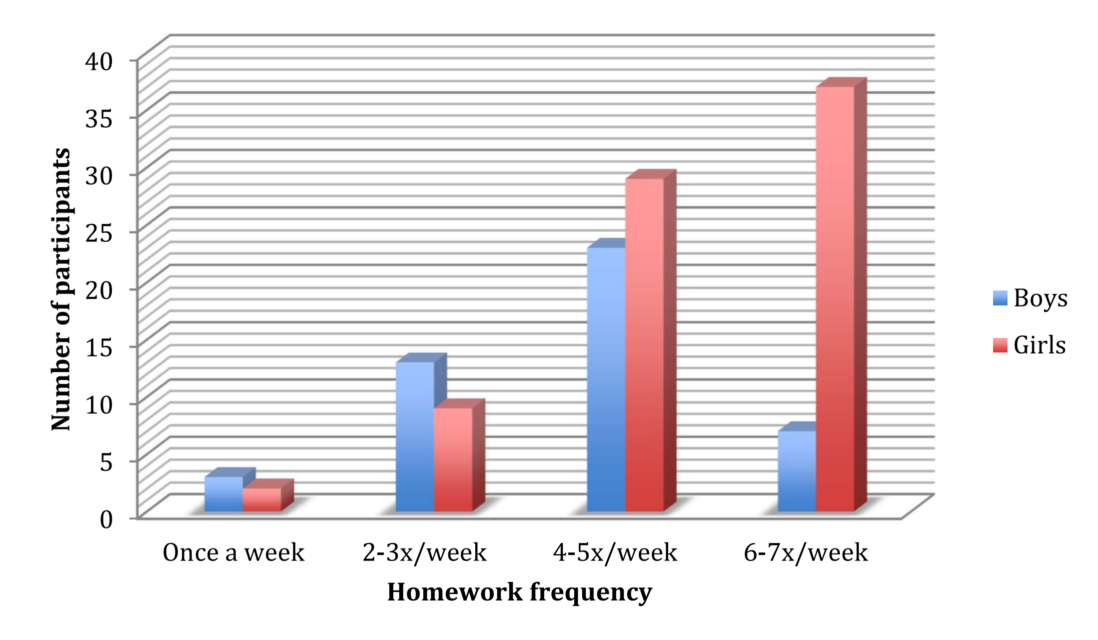


Figure 4.4: Homework frequency: boys vs girls (n=123)

In Figure 4.4 homework frequency is shown. The X-axis represents the Likert scale options ‘once a week’, ‘2-3 times per week’, ‘4-5 times per week’ and ‘6-7x/week’. The Y-axis represents the number of participants that completed the question. The red bar on the graph represents the responses from the girls and the blue bar represents the responses from the boys.

Most learners do homework 4-5 times a week. There is a significant difference in the frequency of homework done between boys and girls in the participation population (p= 0.001). The girls tend to do homework more frequently in the week (6-7 times a week) where the boys tend to do homework 4-5 times a week with very few doing homework 6-7 times a week.

4.5.2.3 Homework Duration

Most learners (n=51; 41%) spent between one and two hours on their homework at a time. There was no statistically significant difference (p=0.548) between the time the learners spent doing homework when comparing the girls and boys.

4.5.3 Educational Information Technology (IT) Usage

The next aspect explored was the use of IT at school and at home for educational activities. The different aspects of educational IT usage are discussed separately. Firstly, the frequency and duration of IT usage at school are discussed. This will be followed by frequency and duration of IT usage at home for homework.

4.5.3.1 Information Technology Usage At School

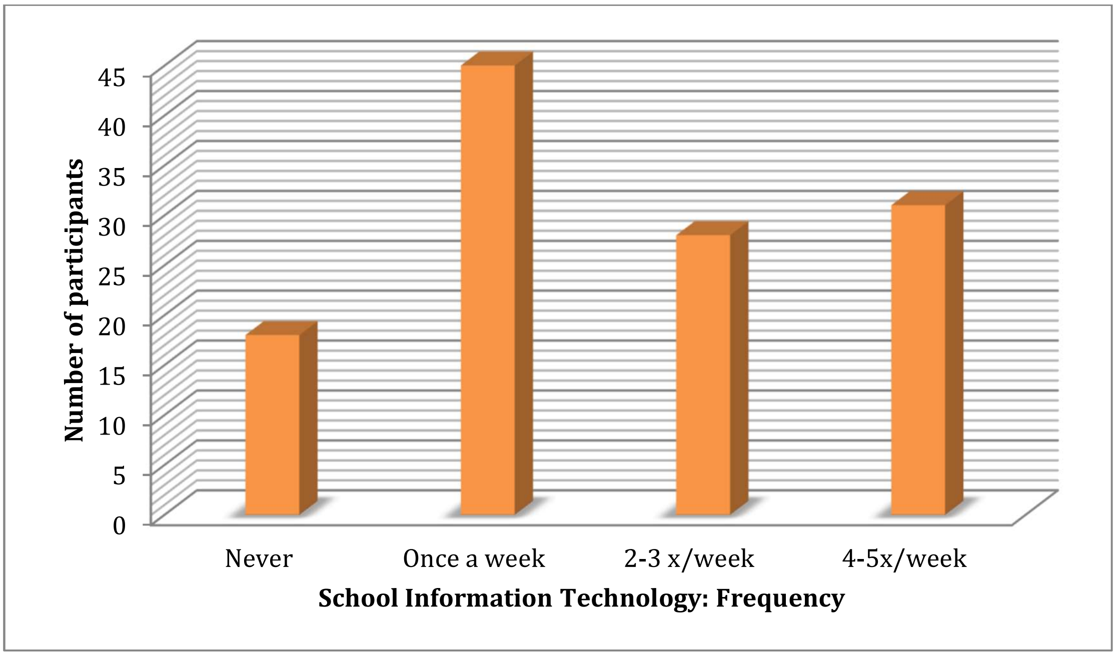


Figure 4.5: School Information Technology: Frequency (n=104)

In Figure 4.5 IT usage at school is shown. The X-axis represents the Likert scale options ‘once a week’, ‘2-3 times per week’, ‘4-5times per week’ and ‘6-7times per week. The Y-axis represents the number of participants that completed the question. There was no difference between the boys and girls and therefore they were not reported separately in the bar graphs.

A total of 85% (n=104/122) of all learners reported using a computer or other information technology (IT) at school. A total of 25% (n=31/122) of all learners reported using IT 4-5 times per week at school. One learner did not disclose any information.

Table 4.3: IT use duration at school on a daily basis (n=106)

IT duration daily at school	Total (n)	Percentage
Less than 1 hour	n=54/106	51%
1-2 hours	n=23/106	22%
3-4 hours	n=14/106	13%
5 hours +	n=15/106	14%

In Table 4.3 the duration of using IT at school on a daily basis is presented. The columns represent the total number of learners and the percentage of learners per time period. The rows represent the time period learners use IT devices at school on a daily basis.

Of the 106 learners that use IT at school 51% (n=54/106) spent less than an hour at a time using IT at school. A total of 27% (n=29/106) of participants used IT for more than 3 hours at a time. One learner did not complete the question. No significant difference was found between boys and girls.

4.5.3.2 <u>Frequency Of IT Usage For Homework</u>

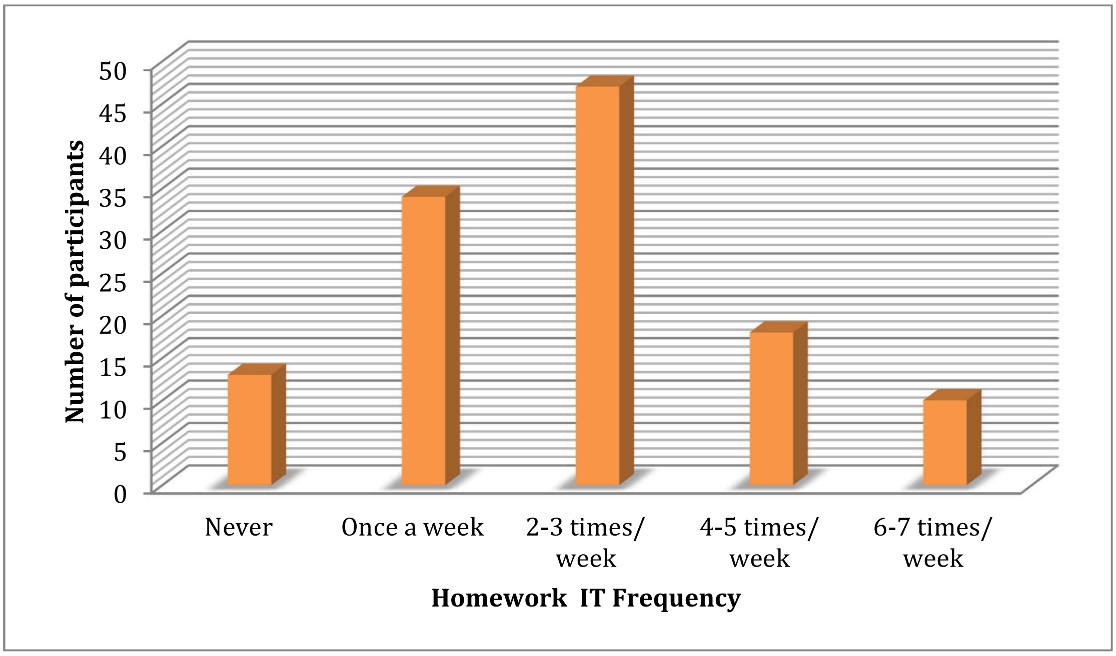


Figure 4.6: Frequency of IT usage for homework (n=112)

In Figure 4.6 frequency of using IT for homework is shown. The X-axis represents the Likert scale options ‘once a week’, ‘2-3 per week’, ‘4-5 per week’ and ‘6-7 per week’. The Y-axis represents the number of learners that completed the question. There was no difference between the boys and girls and therefore they were not reported separately in the bar graphs.

A total of 92% of learners (n=112/122) make use of IT at home for homework. The largest percentage (39%) of learners uses IT 2-3 times a week. One learner did not complete the question.

4.5.3.3 Duration Of IT Usage For Homework

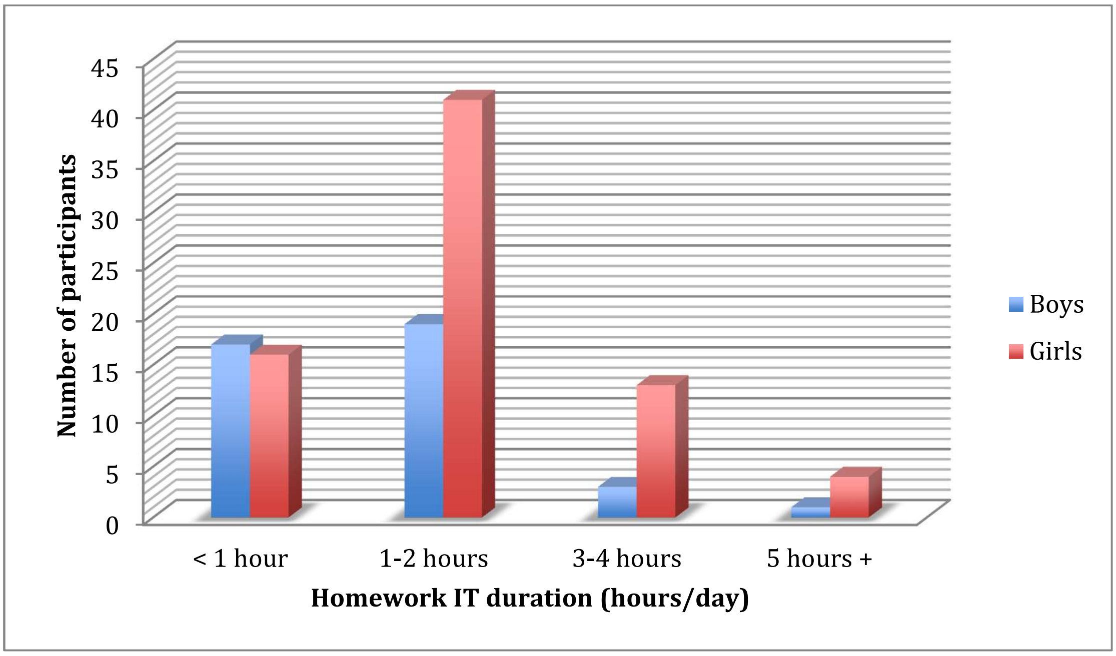


Figure 4.7: Information technology usage for homework, duration (n=114)

In Figure 4.7 the duration of using IT for homework is shown. The X-axis represents the Likert scale options ‘less than one hour’, ‘1-2 hours’, ‘3-4 hours’ and ‘5 hours or more’. The Y-axis represents the number of learners that completed the question. The red bar on the graph represents the responses from the girls and the blue bar represents the responses from the boys.

Most participants (52.63%) spend one to two hours at a time using information technology for homework. The data shows a marginal difference (p=0.087) between boys and girls when it comes to the duration (time spent) on information technology doing homework. Nine learners did not disclose the information regarding homework duration.

4.5.4 READING

The learners did not indicate what posture they assumed in the questionnaire. The frequency and time spent reading was asked to determine a possible association between reading and cervical pain.

More than 55% (n=70/121) of all participants read once a week or less. Two learners did not answer the question. There was no statistically significant difference between the frequency of reading for the boys and the girls (p= 0.301).

More than 56% (n=59/105) of all participants read less than one hour at a time. Eighteen learners did not answer the question as it was a follow-up from reading frequency (27 learners indicated that they never read).

4.5.5 SPORT PARTICIPATION

Ninety percent (90%) of all participants participate in sporting events. There was no difference between the female and male population (p=1.000). A total of 64% of learners participate in sporting activities 1-2 hours at a time. The participation of male and female participants was exactly the same (p=1.000).

Most learners (58%) participated in sport 1-3 times a week. There was no difference between the female and male population (p=0.347).

4.5.6 EXTRAMURAL ACTIVITY PARTICIPATION

A total of 55% (n=67/121) of all participants participate in extramural activities. Two learners did not complete the question. Statistically significant, more girls than boys participate in extra-mural activities (p=0.003).

A total of 75% of learners (n= 55/74) took part in extramural activities 1-3 times per week. Notably, 49 of the learners (49/123) did not complete the question as it followed from the previous question regarding any participation. There was no statistically significant difference between the participation of boys and girls (p=0.337) in terms of frequency of activities.

The majority of participants (52.70%) (n=39/74) participate in one to two hours of extramural activities at a time. There was no statistically significant difference between the boys and the girls (p=0.138)

4.5.7 RECREATIONAL IT USAGE HAND HELD IT DEVICES

Frequency:

Only 23% of all learners (n=27) use handheld IT devices 6-7 times a week. Four learners did not complete the question. There was a significant difference between boys and girls in the frequency of use, with girls using hand-held devices more frequently (p=0.026).

Duration:

Only 13% (n=14/106) of all learners reported spending more than three hours at a time on recreational IT usage. Seventeen learners did not complete the question. Most learners spend less than two hours at a time on recreational IT. There was no statistically significant difference in the duration spent between boys and girls. (p=0.617).

4.5.8 TV GAMES

The majority of learners (n=108/117) play games less than three times a week and 45% never play TV games.

There is a statistically significant difference in frequency of playing TV games between the boys and the girls (p=0.000). A total of 56% of girls (n= 43/77) never played TV games. The boys played more regularly with the greatest population playing two to three times a week (n=15).

Most learners spend less than two hours at a time on TV games. Only 5% spend more than five hours playing TV games. There is a marginally, statistically significant difference between the duration of boys and girls playing TV games with boys spending more time than girls (p=0.067).

4.5.9 PHONE USAGE

More than 96% (n=119/123) reported having their own phones and/or tablets. There was no statistically significant difference between the boys and the girls.

More than half of the learners reported spending one to two hours (n=52/119) at a time on a phone. Quite a high number of children (14%) (n=16/119) spend more than five hours per day on their phone. There was no statistical difference overall between the male and female population although 75% of the learners who spent more than five hours per day on their phones, were in fact girls (n=12/16).

4.5.10 WATCHING TV

Most participants watched television two to three times a week. There was no statistically significant difference between the frequency of watching TV between the male and female population (p=0.866).

Most learners watched one to two hours of TV at a time. Again there was no significant difference between the time the boys and the girls spent watching television (p=0.285).

The association of the various factors and cervical pain will be discussed under section 5.

4.6 CERVICAL AND SCAPULA DYSKINESIS

In this section the presence of cervical and scapula dyskinesis will be presented. The OALT and SDT were used to evaluate dyskinesis. Descriptive statistics (percentage) will be used to report on the presence of dyskinesis. The Fischer exact test will be used to report on differences between the boys and the girls.

In this section the results of cervical posture and scapula resting position are also included. To get the full value of the OALT and SDT an interpretation of the movement tests in context of the cervical posture/ scapula resting position is required. Not only is information about cervical control and dynamic movement important but also information about the ability of the cervical spine to be controlled while shoulder movement occurs.

Cervical posture will be discussed first, followed by a report on the presence of cervical dyskinesis, scapula resting position and the presence of scapula dyskinesis. Lastly the relationship between dyskinesis and posture/ resting position is taken into consideration.

4.6.1 CERVICAL POSTURE

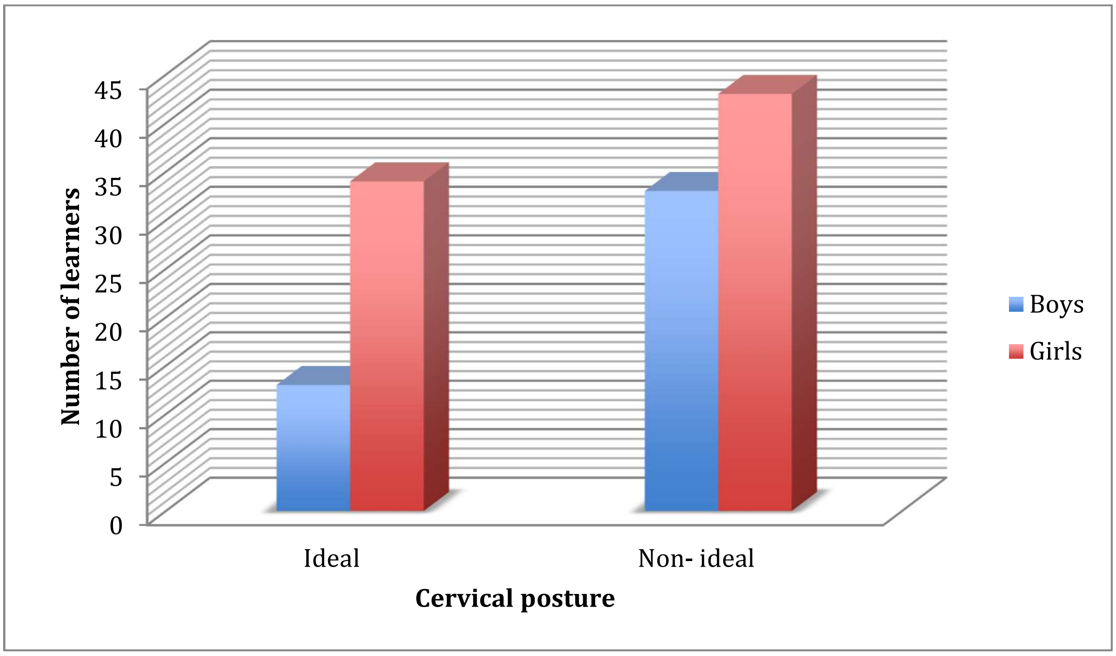


Figure 4.8: Cervical posture in standing

In Figure 4.8 the cervical posture of the participants in a standing position is presented. The X-axis represents the rating of posture as ideal or non-ideal. The Y-axis represents the number of learners that assessed as either ideal or non-ideal. The red bar on the graph represents the posture of the girls and the blue bar represents the posture of the boys.

Posture was assessed against a grid (plumb line). Cervical posture was rated ideal or non-ideal, but the abnormality present was not specified. Non-ideal posture includes forward head posture and poking chin posture. A total of 62% of learners did not have ideal cervical posture during standing posture assessment (n=74/123). It appears that a marginal larger number of boys than girls presented with non-ideal posture but it was not statistically significant (p=0.088).

4.6.2 CERVICAL DYSKINESIS

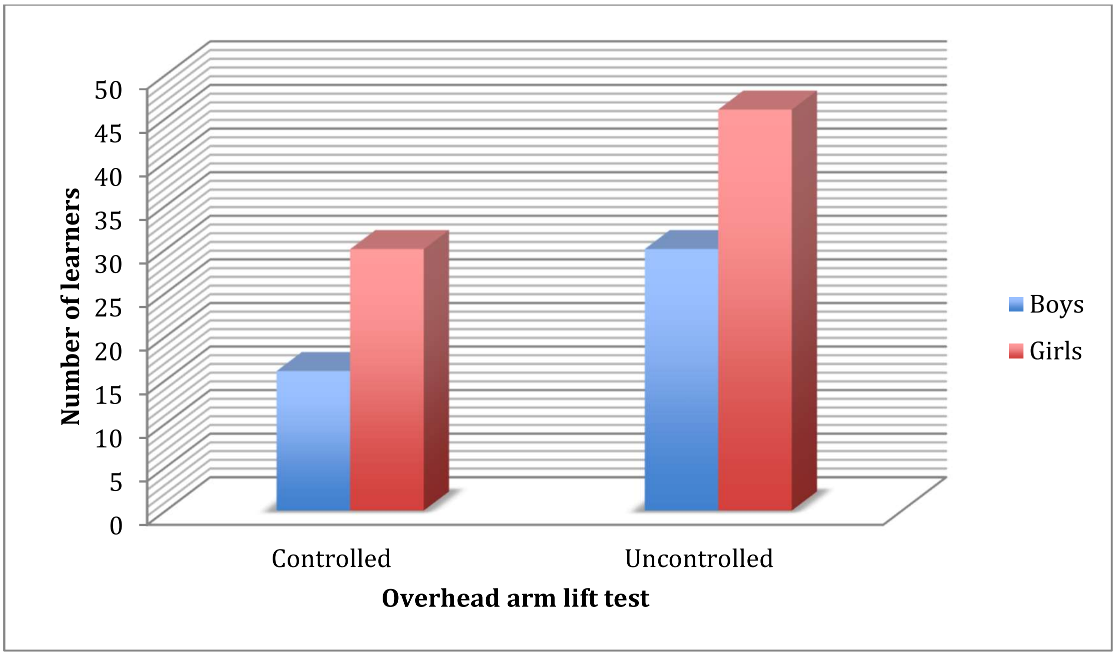


Figure 4.9: Results of Overhead Arm Lift Test (OALT)

In Figure 4.9 the results of the OALT are presented. The X-axis represents the rating of OALT as controlled or uncontrolled. The Y-axis represents the number of learners that rated controlled or uncontrolled. The red colour on the graph represents the outcomes of the girls and the blue colour represents the outcomes of the boys.

Cervical dyskinesis was assessed using the OALT. The OALT was rated as controlled or uncontrolled. More than 62% of all learners presented with cervical dyskinesis (76/122). There was no significant difference between the boys and girls with regards to the OALT (p=0.701).

4.6.3 SCAPULA RESTING POSITION

Scapula resting position was assessed from posterior while standing in front of a gridline. More participants presented with scapula symmetry (54.47%)

than those with asymmetrical positioning (n= 67/123). There was no statistically significant difference between the positions of the boys and the girls (p=0.852).

Left and right scapula positioning was assessed by calculating the position of the spina of the scapula. The spina of the scapula was graded as normal if the spina was in line with T3. If the spina was above the T3 level the scapula position was graded as elevated and below the T3 as depressed. Both elevated and depressed positions were classified as abnormal. The majority of learners (72%) presented with the scapulae in an abnormal resting position (n=89/123). More boys than girls presented with scapula elevation (left p= 0.035, right p= 0.118).

4.6.4 SCAPULA DYSKINESIS

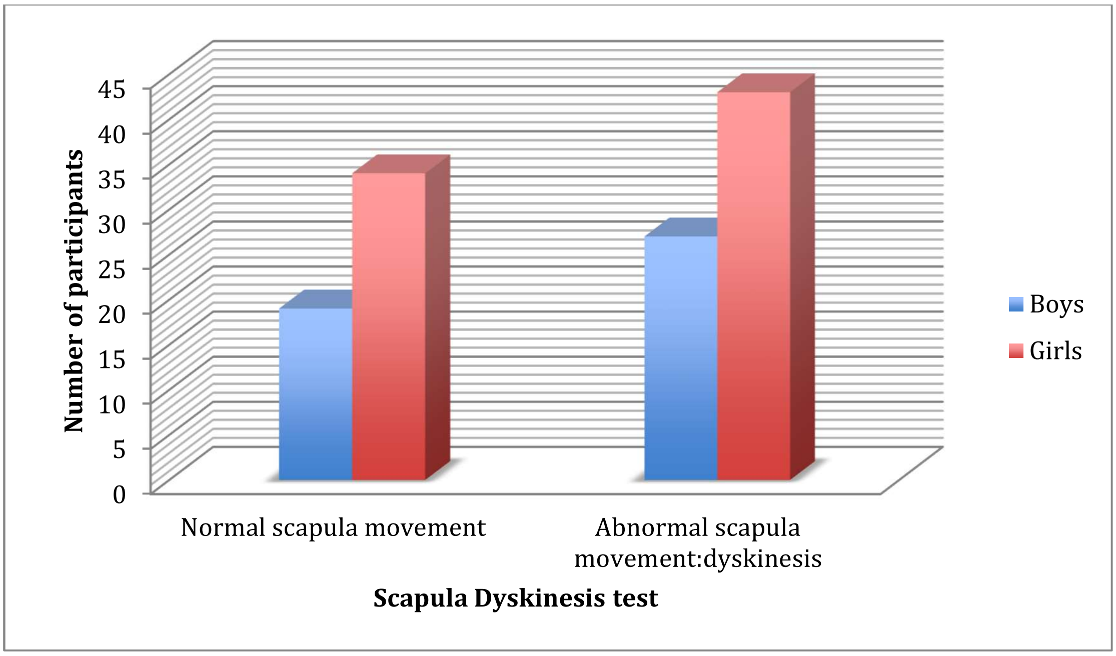


Figure 4.10: Results of Scapula Dyskinesis Test (SDT)

In Figure 4.10 the results of the SDT are shown. The X-axis represents the rating of SDT as normal or abnormal scapula movement. The Y-axis represents the number of learners that presented with either normal or abnormal scapula movement. The red bar on the graph represents the outcomes of the girls and the blue bar represents the outcomes of the boys.

Scapula movement was assessed with the SDT. The movement of the scapulae was rated as normal, subtle or obvious with regard to dyskinesis. The results of normal and subtle scapula movement were combined to use as controlled versus the use of obvious scapula movement as uncontrolled. More than 56% of learners presented with scapula dyskinesis (n=70/123).

4.6.5 DYSKINESIS AND CERVICAL POSTURE

The combined analysis of cervical posture with the OALT and SDT was to determine the ability of the cervical spine stabilisers to control the cervical spine while movement at the shoulder girdle occurs (dissociation).

4.6.5.1 Cervical Posture And OALT

Table 4.4: Combined cervical posture and OALT results

OALT	**Cervical posture**	
	Ideal	**Non-ideal**
Controlled	21	25
Uncontrolled	**26**	50
Total:	47	75

In Table 4.4 the combination of cervical posture and OALT are presented. The columns represent the ideal or non-ideal posture. The rows represent the results of the OALT.

It is interesting to note that 26 of 48 (54%) learners that presented with ideal cervical posture lacked cervical control when the OALT was performed. This implies a lack of functional control or lack or dissociation of movement at the cervical spine with glenohumeral movements. In comparison 25 of 75 (33%)

learners with non-ideal posture was able to control the cervical spine position during the OALT.

4.6.5.2 Cervical Position And SDT

Table 4.5: Combined cervical posture and SDT results

SDT	**Cervical posture:**	
	Ideal	**Non-ideal**
Controlled	25	28
Uncontrolled	**22**	48
Total:	47	76

In Table 4.5 the combination of cervical posture and SDT are presented. The columns represent the ideal or non-ideal posture. The rows represent the results of the SDT.

When combining the results of the SDT and upper quadrant posture, 22 learners presented with ideal posture but presented with scapula dyskinesis.

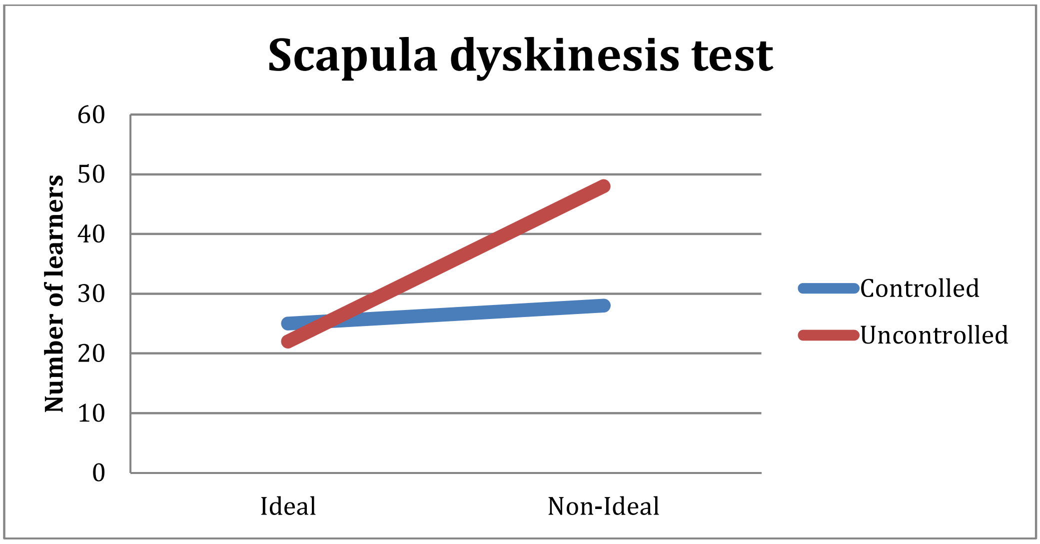


Figure 4.11: Scapula dyskinesis test (SDT) in relation to cervical posture

In Figure 4.11 the results of the SDT in relation to cervical posture are shown. The X-axis represents the rating of cervical posture as ideal or non-ideal. The Y-axis represents the number of learners who presented with controlled or uncontrolled SDT. A marginal statistical significant association of p=0.075 was found between the SDT and non-ideal cervical posture. This implies that learners with a non-ideal cervical posture could potentially be more likely to have scapula dyskinesis.

4.7 ASSOCIATIONS OF CERVICAL PAIN AND DYSKINESIS/ RISK FACTORS

Associations between cervical pain and dyskinesis as well as cervical pain and risk factors as explored in the study were determined. The Fischer's exact test was used to determine any significant associations. Logistic regression analysis was used to determine the increased risk to develop cervical pain when exposed to dyskinesis and risk factors.

The first association to be presented will be between cervical pain and cervical and scapula dyskinesis. Thereafter the associations between risk factors and cervical pain will be presented.

4.7.1 CERVICAL PAIN AND DYSKINESIS

The association between cervical pain and cervical dyskinesis showed no significant difference. There was no statistically significant association (p-value between 0.462 and 1.000) between cervical pain and the OALT.

There was no statistically significant association (p-value between 0.452 and 1.000) between scapula dyskinesis and cervical pain (today, last week and last 3 months).

In Table 4.6 the association between cervical pain and the outcomes of the dyskinesis tests with regards to the Fischer's exact (p- values) and odds ratios are presented. The columns represent the outcomes, p-value and odds ratio for the scapula and cervical dyskinesis tests. The rows represent cervical pain in the categories: pain on the day, pain in previous week, pain in last three months and pain frequency.

The positive outcome refers to the presence of dyskinesis with the SDT and OALT tests whereas the negative outcome refers to the absence of dyskinesis.

Table 4.6: SDT and OALT and association with cervical pain

	Scapula Dyskinesis Test (SDT)				**Overhead Arm Lift Test (OALT)**			
	Positive	**Negative**	**p-value**	**Odds ratio (95% CI)**	**Positive**	**Negative**	**p-value**	**Odds ratio (95% CI)**
Cervical pain on day of assessment	69	53	0.658	1.298 (0.532; 3.165)	26	95	0.652	0.795 (0.328; 1.931)
Cervical pain in previous week	69	53	0.452	1.361 (0.638; 2.904)	44	77	1.000	0.960 (0.446; 2.063)
Cervical pain in the last three months	70	52	0.583	1.282 (0.622; 2.643)	63	58	0.578	0.800 (0.380; 1.684)
Cervical pain frequency	69	53	1.000	1.184 (0.444; 3.157)	20	101	0.462	1.53 (0.539; 4.343)

There was no statistical significant association between cervical pain (any category) and scapula or cervical dyskinesis. The odds ratio (95% CI) also showed no significant prediction of cervical pain (any category) and an increase in the likelihood of dyskinesis.

4.7.2 CERVICAL PAIN AND ASSOCIATED RISK FACTORS

The risk factors presented earlier in Chapter 4, were compared to cervical pain. As four different categories of cervical pain were described initially, the risk factors will be compared to all four categories. The cervical pain categories include: cervical pain on day of assessment, cervical pain in the previous week, cervical pain in the last three months and cervical pain frequency.

Risk factors include sex and age as part of the demographic information collected. Headaches and perceived weight of schoolbag are other risk factors that are included. Seated activities are categorised into educational and recreational activities. Lastly, sport and other extramural activities are included.

Seated activities as well as sport and extramural activities were assessed according to frequency of participation and duration at a time while participating. The duration of seated activities as well as that of sport and extramural activities was compared to cervical pain.

The first risk factor that was compared with cervical pain is sex.

4.7.2.1 Risk Factor: Sex

Table 4.7 describes the association between cervical pain and sex with regards to the Fischer's exact (p-values) and odds ratios. The aim of the odds ratio calculation is to determine the increased risk for girls to present with cervical pain in time period assessed or with a high frequency of cervical pain.

In Table 4.7 sex as a risk factor related to cervical pain in the learners, is presented. The columns represent the total number of boys, girls, and the p-value for the difference between girls and boys, and the odds ratio for girls to develop cervical pain as compared to boys. The rows represent cervical pain in the categories: pain on the day, pain in previous week, pain in last three months and pain frequency.

Table 4.7: Sex and the association with cervical pain

Sex				
	Boys	**Girls**	**p-value**	**Odds ratio (95% CI)**
Cervical pain on day of assessment	7	19	0.256	1.857 (0.705; 4.889)
Cervical pain in previous week	14	30	0.338	1.490 (0.679; 3.267)
Cervical pain in the last three months	18	45	0.040*	2.258(1.049; 4.857)
Cervical pain frequency	4	16	0.083	2.800 (0.856; 9.156)

* = p-value statistically significant

The Fischer exact test was used to determine the difference between girls and boys and the association with cervical pain. There was no statistically significant association between cervical pain today and cervical pain in the last week and the sex of the learners. There was a statistically significant association between the girls and cervical pain in the last three months. From this calculation it is evident that girls in this group have an increased risk (OR= 2,258) to have cervical pain over a three-month period compared to the boys.

There was a marginally significant association between higher cervical pain frequency and pain in the last three months in girls, more so than for boys. This implies that girls are more likely to have cervical pain over a longer period of time and on a more regular basis.

4.7.2.2 Risk Factor: Age

The second risk factor that was compared to cervical pain was age.

Learners participating in the study were 12-, 13- or 14-years-old. The odds ratio represented in this table is the age stipulated compared to a year younger e.g. age 13 compared to age 12, and age 14 compared to age 13.

Table 4.8: Age and the association with cervical pain

	Age							
	12		13		14		p-value	Odds ratio (95% CI)
	Neg	Pos	Neg	Pos	Neg	Pos		
Cervical pain on day of assessment	13	5	73	14	8	6	0.054*	**Age 13**: 0.498 (0.151; 1.643) **Age 14**: 1.950 (0.426; 8.920)
Cervical pain in previous week	11	7	58	29	7	7	0.477	**Age 13**: 0.789 (0.274; 2.252) **Age 14**: 1.571 (0.370; 6.660)
Cervical pain in the last three months	10	8	42	45	6	8	0.763	**Age 13**: 1.339 (0.479; 3.739) **Age 14**: 1.666 (0.393; 7.054)
Cervical pain frequency	14	4	76	11	10	4	0.190	**Age 13**: 0.506 (0.139; 1.843) **Age 14**: 1.400 (0.272; 7.188)

* = p-value statistically significant

In Table 4.8 age as risk factor related to cervical pain in the learners is presented. The columns represent the total number of learners ages 12, 13 and 14, the p-value for the association between each age group respectively (age 12, age 13 and age 14) and cervical pain, and the odds ratio for older learners to develop cervical pain. The rows represent cervical pain in the categories: pain on the day, pain in previous week, pain in last three months and pain frequency.

There was a statistically significant association between the age of the participants and cervical pain as experienced on the day of the data collection (p=0.054). This implies that older learners had statistically significant greater cervical pain on the day of assessment.

There was no statistically significant association between the age of participants and cervical pain in the previous week or in the previous three months. There was also no statistically significant association between the age of participants and a higher pain frequency.

4.7.2.3 Risk Factor: Headaches

The next factor that was explored was headaches. The presence of headaches could potentially indicate the possibility for psychosocial influence in the pain reported (El-Metwally et al., 2007b).

Table 4.9: Headaches and the association with cervical pain

Headaches				
	Outcome		p-value	Odds ratio (95% CI)
	Neg	Pos		
Cervical pain on day of assessment	96	26	0.025*	3.37 (1.248; 9.121)
Cervical pain in previous week	77	44	0.034*	2.84 (1.128; 7.160)
Cervical pain in the last three months	59	63	0.185	1.89 (0.754; 4.743)
Cervical pain frequency	102	20	0.001*	5.80 (1.936; 17.372)

* = p-value statistically significant

In Table 4.9 headache as risk factor related to cervical pain in the learners is presented. The columns represent the outcome (positive or negative) for the presence of headaches, the p-value for the association between headaches and cervical pain, and the odds ratio for learners with headaches to develop cervical pain. The rows represent cervical pain in the categories: pain on the day, pain in previous week, pain in last three months and pain frequency.

There is a statistically significant association between headaches and cervical pain on day of data collection, cervical pain in the previous week and a higher pain frequency. This implies that learners with headaches had statistically significant greater cervical pain on the day of assessment (p=0.025), the previous week (0.034) and with a higher pain frequency (how often) (p=0.001). The odds ratio was also high, indicating an increased risk to develop cervical pain with the presence of headaches (OR between 2.84 and 5.80)

There was no statistically significant association between headaches and cervical pain experienced in the previous three months.

4.7.2.4 Risk Factor: Perception Of Schoolbag Weight

Table 4.10: Perceived weight of school bag and association with cervical pain

Perceived heaviness of schoolbag				
	Outcome		p-value	Odds ratio (95% CI)
	Neg	Pos		
Cervical pain on day of assessment	91	25	0.066**	2.714 (0.970; 7.589)
Cervical pain in previous week	73	43	0.079**	2.125 (0.943: 4.788
Cervical pain in the last three months	55	61	0.708	0.839 (0.399; 1.765)
Cervical pain frequency	96	20	0.322	1.815 (0.636; 5.177)

** = p-value marginal, statistically significant

In Table 4.10 perceived heaviness of schoolbag as risk factor related to cervical pain in the learners is presented. The columns represent the outcome (positive= heavy or negative= not heavy) for the perception of schoolbag weight, the p-value for the association between perceived schoolbag heaviness and cervical pain, and the odds ratio for learners with perceived heaviness of schoolbags to develop cervical pain. The rows represent cervical pain in the categories: pain on the day, pain in previous week, pain in last three months and pain frequency.

There is a marginal significant association between the perceived heaviness of the schoolbags and cervical pain on the day of assessment and in the last week. There is no statistically significant association between perceived weight of schoolbags and reported cervical pain experienced in the previous three months. There was no statistically significant association between the frequency of cervical pain and perceived heaviness of the schoolbag.

4.7.2.5 Risk Factor: Seated Educational Activities

Seated educational activities are divided into four different categories:

i. **IT usage** at school is the time information technology was used during school hours. This includes the time spent on IT as a subject as well as the usage of electronic tablets instead of text books.
ii. **Homework IT** represents the time spent using information technology (including desktop computers, laptops or electronic tablets) at home to complete homework.
iii. **Education** is the time the learners spend at school per day.
iv. **Educational IT** represents the time using information technology at school for educational purposes.

Table 4.11: Cervical pain on day of assessment compared to educational factors

	Factor (in time)	**Outcome**	**N**	**Mean (SD)**	**p-value***	**Relative risk for 1 hr increase (95% CI)****
Cervical pain on day of assessment	IT usage at school	Negative	85	2.09 (1.477)		
		Positive	20	2.55 (1.701)	0.231	1.205 (.888 ; 1.634)
	Homework IT	Negative	88	2.10 (1.093)		
		Positive	25	2.2 (1.225)	0.702	1.0798 (.732 ; 1.593)
	Education	Negative	96	8.90 (1.167)		
		Positive	26	8.43 (.962)	0.061	0.658 (.421 ; 1.03)
	Education IT	Negative	90	4.03 (2.107)		
		Positive	25	4.24 (1.964)	0.661	1.049 (.850 ; 1.294)

Table 4.12: Cervical pain in the previous week compared to educational factors

	Factor (in time)	**Outcome**	**N**	**Mean (SD)**	**p-value***	**Relative risk for 1 hr increase (95% CI)****
Cervical pain in previous week	IT usage at school	Negative	67	2.179 (1.497)		
		Positive	38	2.184 (1.591)	p= 0.987	1.002 (0.771 ; 1.303)
	Homework IT	Negative	70	1.971 (0.992)		
		Positive	43	2.372 (1.273)	p= 0.064	1.375 (0.977 : 1.936)
	Education	Negative	78	8.747 (1.125)		
		Positive	44	8.915 (1.170)	p= 0.437	1.138 (0.824 ; 1.572)
	Education IT	Negative	72	3.944 (2.068)		
		Positive	43	4.302 (2.076)	p= 0.372	1.869 (0.906 ; 1.303)

* p-value <0.05 denotes a statistically significant difference

** significant increase/decrease in relative risk of 95%CI excludes the value 1, i.e. RR=1

Table 4.13: Cervical pain in the previous three months compared to educational factors

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain last three months	IT usage at school	Negative	55	2.35 (1.624)		
		Positive	50	2.02 (1.392)	p=0.275	0.866 (.669 ; 1.120)
	Homework IT	Negative	56	2.036 (1.078)		
		Positive	57	2.210 (1.160)	p=0.408	1.153 (.825 ; 1.610)
	Education	Negative	59	8.853 (1.164)		
		Positive	63	8.765 (1.124)	p= 0.670	.934 (.683 ; 1.277)
	Education IT	Negative	56	4.340 (2.290)		
		Positive	59	3.847 (1.818)	p= 0.204	.889 (.741 ; 1.066)

Table 4.14: Cervical pain frequency compared to educational factors

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain frequency	IT usage at school	Negative	88	2.159 (.159)	p= 0.739	
		Positive	17	2.294 (.418)		1.059 (.76 ; 1.48)
	Homework IT	Negative	94	1.989 (1.021)		
		Positive	19	2.789 (1.357)	**p= 0.004***	**1.751 (1.168 ; 2.625**)
	Education	Negative	102	8.748 (1.123)		
		Positive	20	9.11 (1.207)	p= 0.191	1.308 (.873 ; 1.959)
	Education IT	Negative	96	3.927 (2.017)		
		Positive	19	4.842 (2.218)	p= 0.078	1.218 (.974 ; 1.522)

* p-value <0.05 denotes a statistically significant difference

** significant increase/decrease in relative risk of 95% CI excludes the value 1, i.e. RR=1

In Tables 4.11-4.14 the duration of seated educational activities as risk factors related to cervical pain in the learners are presented. The columns represent the outcome (positive= presence of cervical pain or negative= absence of cervical pain) for the seated activities, the mean value (and standard deviation) for each of the seated activities, the p-value for the association between seated educational activities and cervical pain and the odds ratio for learners with a high duration of seated activities to develop cervical pain. The rows represent each of the seated educational activities. Table 4.11 compares cervical pain on the day of assessment. Table 4.12 compares cervical pain in the previous week. Table 4.13 compares cervical pain in the previous three months. Table 4.14 represents cervical pain frequency for educational seated activities.

There was a marginal, statistically significant association between cervical pain on the day of assessment and the time spent at school (p=0.061). There was a marginally significant association between cervical pain in the previous week and time spent doing homework on IT devices (p=0.064). There was a significant association between a higher cervical pain frequency and the duration of time spent doing homework on IT devices (p=0.004). There was a marginally statistical association between time spent using IT at school and a higher cervical pain frequency (p=0.078). This implies that the use of IT devices for homework can lead to cervical pain, especially when using the IT devices for long periods of time.

4.7.2.6 Risk Factor: Recreational Seated Activities

Seated recreational activities included:

i. Time spend **reading**.
ii. Time using IT for recreation (**Fun IT**) e.g. playing on a mobile device such as Nintendo, PSP or an electronic tablet.
iii. **TV games** include all console games played on a big screen, in comparison to the recreational IT (Fun IT) that is on handheld devices and screens.
iv. **Phone time** includes the time spent on a mobile phone.
v. **TV time** includes the time per day spent watching television at home.

Table 4.15: Cervical pain on day of assessment compared to seated recreational factors

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain on day of assessment	Reading	Negative	83	1.80 (1.187)		
		Positive	22	1.82 (1.259)	0.937	1.016 (.687 ; 1.503)
	Fun IT	Negative	81	1.63 (.914)		
		Positive	24	2.29 (1.488)	**p=0.009***	**1.618 (1.103 ; 2.372)****
	TV games	Negative	54	1.87 (1.011)		
		Positive	20	2.6 (1.465)	**p= 0.018***	**1.635 (1.069 ; 2.502)****
	Phone time	Negative	89	2.393 (1.275)		
		Positive	24	2.792 (1.719)	p= 0.212	1.222 (.891 ; 1.676)
	TV time	Negative	89	2.450(1.340)		
		Positive	25	2.6 (1.225)	p=0.6143	1.090 (.782 ; 1.521)

* p-value <0.05 denotes a statistically significant difference

** significant increase/decrease in relative risk of 95% CI excludes the value 1, i.e. RR=1

Table 4.16: Cervical pain in the previous week compared to seated recreational factors

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain in previous week	Reading	Negative	67	1.701 (1.101)		
		Positive	38	1.973 (1.345)	p=0.265	1.205 (0.867 ; 1.671)
	Fun IT	Negative	66	1.727 (1.016)		
		Positive	39	1.872 (1.24)	p= 0.518	1.125 (.789 ; 1.605)
	TV games	Negative	47	2.085 (1.158)		

		Positive	27	2.037 (1.255)	p= 0.868	.966 (.644 ; 1.447)
	Phone time	Negative	72	2.333 (1.321)		
		Positive	41	2.731 (1.467)	p=0.141	1.230 (.933 ; 1.622)
	TV time	Negative	71	2.408 (1.283)		
		Positive	43	2.605 (1.365)	p= 0.441	1.120 (.840 ; 1.494)

Table 4.17: Cervical pain in the last three months compared to seated recreational factors

	Factor (in time)	**Outcome**	**N**	**Mean (SD)**	**p-value***	**Relative risk for 1 hr increase (95% CI)****
Cervical pain last three months	Reading	Negative	52	1.827 (1.200)		
		Positive	53	1.773 (1.441)	p= 0.821	.963 (.698 ; 1.328)
	Fun IT	Negative	55	1.745 (1.040)		
		Positive	50	1.82 (1.173)	p= 0.731	1.064 (.750 ; 1.510)
	TV games	Negative	36	2.11 (1.116)		
		Positive	38	2.026 (1.262)	p=0.7609	.940 (.638 ; 1.386)
	Phone time	Negative	57	2.263 (1.343)		
		Positive	55	2.727 (1.394)	p= 0.075	1.283 (.972 ; 1.693)
	TV time	Negative	54	2.370 (1.278)		
		Positive	60	2.633 (1.377)	p=0.295	1.163 (.878 ; 1.541)

Table 4.18: Cervical pain frequency compared to seated recreational factors

	Factor (in time)	**Outcome**	**N**	**Mean (SD)**	**p-value***	**Relative risk for 1 hr increase (95% CI)****
Cervical pain frequency	Reading	Negative	86	1.802 (1.196)		
		Positive	19	1.789 (1.228)	p=0.966	.990 (.651 ; 1.507)
	Fun IT	Negative	87	1.701 (.990)		
		Positive	18	2.167 (1.505)	p= 0.103	1.393 (.928 ; 2.091)
	TV games	Negative	62	2 (1.086)		
		Positive	12	2.417 (1.621)	p=0.268	1.311 (.811 ; 2.122)
	Phone time	Negative	95	2.357 (1.320)		
		Positive	18	3.111 (1.567)	**p= 0.034***	**1.445 (1.020 ; 2.048)****
	TV time	Negative	95	2.452 (1.327)		
		Positive	19	2.631 (1.257)	p= 0.590	1.107 (.767 ; 1.597)

* p-value <0.05 denotes a statistically significant difference

** significant increase/decrease in relative risk of 95% CI excludes the value 1, i.e. RR=1

In Tables 4.15-4.18 seated recreational activities as risk factors related to cervical pain in the learners are presented. The columns represent the outcome (positive= presence of cervical pain or negative= absence of cervical pain) for the seated activities, the mean value (and standard deviation), the p-value for the association between seated recreational activities and cervical pain and the odds ratio for learners with a high duration of seated recreational activities to develop cervical pain. The rows represent each of the seated recreational activities. Table 4.15 compares cervical pain on the day of assessment. Table 4.16 compares cervical pain in the previous week. Table 4.17 compares cervical pain in the previous three months. Table 4.18 represents cervical pain frequency for recreational seated activities.

There is a statistically significant association between cervical pain on the day and the participation in recreational IT usage on handheld devices (p=0.009). There is also a statistically significant association between cervical pain on the day of assessment and playing TV games (p=0.018). The odds ratio in both categories are Fun IT 1.618 and TV games 1.635. This implies that the risk of developing cervical pain increased by 1.6 times for every additional hour the participants spent using the various devices.

There was a marginally significant association between the time spent on a mobile phone and reported cervical pain of the previous three months (p=0.075). A significant association was observed between cervical pain of a higher frequency and phone time (p=0.034). The odds ratio for a relative increase in the risk for cervical pain is 1.445 when using a mobile phone.

4.7.2.7 <u>Risk Factor: Sport And Extramural Activity Participation</u>

Sport participation and extramural activity participation were assessed according to the duration spent per time of activity and not the number of times the learners participated in these activities per week.

Table 4.19: Cervical pain on the day of assessment compared to sport and extramural activities

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain on day of assessment	Sport	Negative	87	2.03 (.618)		
		Positive	24	2.04 (.550)	p=0.959	1.020 (.480 ; 2.169)
	Extramural activities	Negative	56	1.670 (.630)		
		Positive	17	1.765 (.664)	p=0.700	1.186 (.504 ; 2.794)

Table 4.20: Cervical pain in the previous compared to sport and extramural activities

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain in previous week	Sport	Negative	71	2.042 (.571)		
		Positive	40	2.025 (.660)	p=0.885	0.953 (.499 ; 1.819)
	Extramural activities	Negative	41	1.707 (.602)		
		Positive	32	1.718 (.121)	p=0.94	1.023 (.494 ; 2.144)

Table 4.21: Cervical pain in the last three months compared to sport and extramural activities

	Factor (in time)	Outcome	N	Mean (SD)	p-value*	Relative risk for 1 hr increase (95% CI)**
Cervical pain last three months	Sport	Negative	55	2.091 (.586)		
		Positive	56	2 (.603)	p=0.422	.770 (.408 ; 1.452)
	Extramural activities	Negative	32	1.75 (.672)		
		Positive	41	1.683 (.610)	p=0.657	.844 (.405 ; 1.761)

Table 4.22: Cervical pain frequency compared to sport and extramural activities

	Factor (in time)	**Outcome**	**N**	**Mean (SD)**	**p-value***	**Relative risk for 1 hr increase (95% CI)****
Cervical pain frequency	Sport	Negative	93	2.085 (.594)		
		Positive	18	1.833 (1.526)	p= 0.119	.502 (.210 ; 1.120)
	Extramural activities	Negative	58	1.741 (.609)		
		Positive	15	1.6 (.737)	p=0.445	.693 (.273 ; 1.760)

In Tables 4.19-4.22 sport and extramural activities as risk factors related to cervical pain in the learners are presented. The columns represent the outcome (positive= presence of cervical pain or negative= absence of cervical pain) for the activities, the mean value (and standard deviation) of the sport and extramural activities, the p-value for the association between activities and cervical pain and the odds ratio for learners with a high duration of activities to develop cervical pain. The rows represent sport or extramural activities. Table 4.19 compares cervical pain on the day of assessment. Table 4.20 compares cervical pain in the previous week. Table 4.21 compares cervical pain in the previous three months and Table 4.22 represents cervical pain frequency for sport and extramural activities.

No association was found between sport and extramural activity participation and cervical pain; either today, the previous week or previous three months or a higher cervical pain frequency.

SUMMARY

The results were discussed according to the objectives of the study. The most significant results include the presence of cervical pain of more than 21% in learners on the day of assessment and the presence of cervical dyskinesis (62%) and scapula dyskinesis (56%).

Furthermore, significant associations were found between cervical pain and several factors related to cervical pain. The factors with significant associations include sex (p=0.04), age (p=0.054), headaches (p=0.001), perceived weight of schoolbags (p=0.066), as well as four seated activities. The seated activities were the use of IT during homework (p=0.004), the use of a mobile phone (p=0.034), TV games (p=0.018) and using IT for recreational purposes (p=0.009).

The interpretation and discussion of reported results will be done in Chapter 5.

CHAPTER FIVE

5. DISCUSSION

5.1 INTRODUCTION

The aims of the study were to a) determine the presence of cervical pain in Grade 7 learners in private schools in Tshwane, Gauteng, South Africa; and b) to determine a possible association of cervical pain with scapula or cervical dyskinesis. There is limited literature available about cervical pain in adolescents in South Africa with only two known studies that have been previously completed.

The main findings will be discussed in accordance with the objectives set for the study. The results of each key finding will be interpreted, discussed and compared to existing literature. Limitations that were identified in the literature or during the course of the current study will be highlighted and discussed. Finally, the results will be brought into perspective.

The first aim of the study was to determine the proportion of Grade 7 learners with cervical pain. The second aim of the study was to determine the correlation between seated recreational and educational activities and cervical pain. The third aim was to determine the presence of scapula and cervical dyskinesis as well as the association of scapula and/or cervical dyskinesis with cervical pain. The discussion will be done in accordance to the aims set out above.

5.2 THE PRESENCE OF CERVICAL PAIN

The study found that 21.4% of all participants reported cervical pain on the day of data collection. The percentage increased as 36% of participants reported pain in the last week and 52% reported pain in the last three months, increasing the chances of having persistent cervical pain. This consistent pain is confirmed with an odds ratio of 0.77 (see 4.4.1 page 67)

The results of the study are in line with those of previous studies. International studies report the percentage of cervical pain in adolescents to be between 18% and 40% (Aartun, Boyle, Hartvigsen, Ferreira, Maher, Ferreira et al., 2016; Diepenmaat et al., 2006; Smith et al., 2009). The findings of the current study are consistent to those of the South African study done in the Western Cape. The Western Cape study reported cervical pain to be 20% of all 14-to16-year-olds evaluated (Smith et al., 2009). In contrast, the results of the current study do not relate with the second South African study done in Gauteng. The study by Rhoda et al. (2011) reported 53.6% prevalence of cervical pain in Grade 8-11 learners. The results of the study are inconsistent due to the group allocation that increased in numbers with the increased age of learners. Most learners (45%) fell into the Grade 11 group. Therefore, the majority of learners are older than in the current study. As has been found in previous literature (El-Metwally et al., 2004; Mikkelsson et al., 2008; Auvinen et al., 2010; Paananen et al., 2010b; Shan et al., 2013; Aartun et al., 2014; Jussila et al., 2014), and also in this study, cervical pain increases with the age of the adolescent population.

5.3 CERVICAL PAIN AND ASSOCIATING FACTORS

Several factors associated with cervical pain were explored in the study. Not all factors evaluated are discussed as there was either no significant association between these factors and pain or the findings were in line with previous literature and therefore does not contribute to the existing body of knowledge. The factors that did not have a significant association with cervical pain in the study include sport, extramural activities, school time, IT usage at school and watching TV.

The factors explored in the study that will be discussed include sex and age as demographical factors, headaches and perceived weight of schoolbag as psychosocial factors, and factors related to seated educational and recreational activities. The findings regarding these factors significantly contribute to the body of knowledge by confirming what has been seen in previous studies.

Demographic factors

As in the majority of international studies (Diepenmaat et al., 2006; El-Metwally et al., 2007b; Auvinen et al., 2010; Jussila et al., 2014; Ruivo et al., 2014; Gustafsson et al., 2017) statistically significantly more girls than boys presented with cervical pain in the previous three months (p=0.040) in the current study.

There are three possible reasons why girls have more pain than boys. Firstly, girls have a decreased pressure pain threshold (Straker et al., 2011). The decreased pressure pain threshold could lead to increased symptoms with sustained positions where loading of the spine occurs in e.g. sitting and studying (Fillingim et al., 2009). Secondly, girls and boys have different postures when sitting (Straker et al., 2009). Girls tend to sit more upright than boys, with more cervical flexion when working at a desk leading to more stress on the cervical structures and fatigue of the cervical muscles (Poussa et al., 2005; Straker et al., 2011). Thirdly, girls may be more willing to disclose pain and discomfort than boys, as seen in other studies (Ståhl et al., 2004; Dianat et al., 2014; Myrtveit et al., 2014).

One could also question the possible role that hormonal changes plays. This has been explored in a study relating to puberty by Wedderkopp, Andersen, Froberg and Leboeuf-Yde (2005). No significant association between cervical pain and puberty has been found.

The results of the second demographic factor, age, are also in accordance with previous studies. The older participants (14-year-olds) had significantly more cervical pain on the day of evaluation (p=0.054). There was a statistically significant association between cervical pain on the day of assessment and the ages of the participants (p=0.054). The older group had significantly more pain. This would imply that the presence of cervical pain increases with age. In a previous study done by Shan et al. (2014) the main reasons for an increase of cervical pain with age were increased levels of stress as well as increased sustained periods of sitting. In the current study the learners were all in the same grade implying that the periods of sitting should be the same. As periods of sitting are the same one might suggest from the results of the study by Shan et al. (2014) that the individual levels of stress could be a contributing factor to the increase of pain in older participants.

Psychosocial factors

Headaches (frequency) and perceived weight of the schoolbag are the psychosocial factors that will be discussed. Headaches had a significant association with cervical pain whereas perceived weight of schoolbag had a marginal statistically significant association with cervical pain.

Headaches are a physical sign that indicates a strong psychosocial component to pain (El Metwally et al. 2007). There were significant associations found between cervical pain and headaches: pain on day of assessment ($p>0.025$), pain in last week ($p> 0.034$), pain frequency ($p>0.001$). The association between cervical pain and headaches are in line with previous literature (Smith et al., 2009; Rees et al., 2011). Smith et al (2009) found that subjects with high psychosocial scores were twice as likely to suffer from headaches than those with low psychosocial scores. In a study by Rees et al. (2011) the association of mental health issues with cervical pain was assessed. The researchers used the Youth Self Report as part of their assessment. Headaches were part of the classification for internalisation/ emotional problems. This was further classified into somatic pain. An association between somatic and comorbid cervical pain was found.

There is a marginally significant association between the perception of schoolbag weight and cervical pain on the day of assessment ($p=0.066$). This finding is in line with the study of Haselgrove et al. (Haselgrove et al., 2008) that found a significant association (p=0.001) between cervical pain and perceived schoolbag weight. Perceived weight reveals that it is more the perception of schoolbag weight that is of significance than the actual weight of the schoolbag itself.

It is evident that both headaches and the perceived weight of the schoolbag have associations with cervical pain, contributing to the psychosocial component of pain.

<u>Educational and recreational factors</u>

The factors that have been included in the discussion are IT (information technology) homework, recreational IT usage, TV games, phone time and frequency of reading. These factors all had statistically significant or marginally statistically significant associations with cervical pain.

The use of IT during homework had a statistically significant association with high cervical pain frequency (p=0.004). The participants indicated that they did homework for an average of one to two hours per day. The findings are in line with findings by Rhoda et al. (2011) who found a statistically significant association (p=0.03) between usage of computers outside of school and cervical pain.

The gravitational demand on the cervical spine is a noteworthy factor that may play a role while using IT at home. Chaffin (1973) compared activities done in a 15º head flexion with a 30º head flexion. The study found that a head flexion of 15º caused no discomfort or electromyographic changes after 6 hours (50 minute position hold and 10 minute rest). However, the 30º head flexion position led to fatigue described as continuous cramping with deep hot pain.

One can argue that learners are sitting on the same chairs and in the same posture when at school, whereas at home the learners can sit on various surfaces (including chairs, beds, sofas and even floors) and in various positions. This is linked to a study done by Vasavada, Nevins, Monda, Hughes and Lin et al. (2015) that assessed different postures while using electronic tablets. The study found that a high position for the tablet (tablet positioned on a desk with the cover in a high position) was the best with regards to gravitational demand. Whereas a low or flat position of the tablet (positioned on a desk with the cover in a low position or the tablet lying flat on a desk) or the use of the subject's lap, lead to more gravitational demand. The gravitational demand is three to five times more in a low tablet position. The cervical spine is in a flexed position during the low tablet position and this leads to more demand on the long cervical extensor muscles to maintain posture. This is linked to the results found by Chaffin (1973) that indicate that with more cervical flexion (30º) there is more fatigue in the cervical musculature. Similar effects were seen in an earlier study that found that a higher gravitational demand leads to muscle fatigue (Gosselin, Rassoulian and Brown, 2004).

One can argue that the home environment is not specified and controlled for each learner and therefore the participants might not have been in an ergonomically suitable position. If the learners had a 30º head flexion in the position they were using the digital device, muscle fatigue would kick in sooner, leading to cervical pain. Even though the learners were only sitting for one to two hours compared to the six hours in the study by Chaffin (1973) it could be argued that learners had already been sitting at school for at least six hours at the time and so being at home is not their first exposure to sitting for the day. Furthermore, possible muscle fatigue could kick in earlier due to the positioning of the IT device during homework.

Considering that learners did not disclose what electronic device was used for homework at home, it is possible that the device was not ideally positioned. Learners might have experienced an increase in gravitational demand that can lead to cervical pain.

The frequency of reading also had a statistically significant association with cervical pain in the last week ($p=0.028$) and a high cervical pain frequency (p=0.011). The finding is in line with Hellstenius (2009) that found that sitting for two hours or more would elicit or exacerbate cervical pain and/or headaches, especially with reading and computer use. Even though the position assumed during reading was not disclosed it can be assumed that the learner was in a sustained static position. Gravitational demand, as discussed earlier, could play a role as well (Chaffin, 1973). This could lead to fatigue of the cervical muscles which in turn could lead to cervical pain.

The next factor that had an association with cervical pain was recreational IT usage. There was a statistically significant association between the use of IT for recreational purposes and cervical pain on the day of evaluation (p=0.009). Recreational IT includes browsing on the Internet using an IT device, being on social media and playing games. The findings are in line with the study of Rhoda et al. (2011) who found that there was a statistical significant association (p=0.03) between the use of computers outside of school and cervical pain.

The next factor that had a significant association with cervical pain was TV games. TV games were specified as the use of game consoles like Nintendo or PlayStation, where a controller is handheld but a large screen is used for the actual game visuals. A statistically significant association was found between playing TV games and cervical pain today (p=0.018). The findings are in line with studies done by Ramos et al.(2005) and Berolo, Wells and Amick III (2011) that found an association between IT usage (computers, electronic games and cell phones) and cervical pain. The association could be as a result of a number of causes.

One potential reason could be the posture the children assume while playing as they concentrate on the game and do not focus on the way they sit or lay. The second potential reason could be the time that the children spend playing games. A prolonged period of playing games will lead to muscle fatigue of the long cervical extensors that could lead to cervical pain (Gosselin et al., 2004). This could be leading to strain on the cervical spine through the adjustment of posture (forward head posture, shoulder protraction) to compensate for the muscle fatigue. The fatigue will also put more strain on the cervical joints with the overuse of the cervical musculature.

The last educational or recreational factor that had a significant association with cervical pain is general phone usage.

There was a statistically significant association between cervical pain frequency and the hours spent on a phone. This finding agrees with other literature that found an association between cervical pain and smart phone users (Berolo et al., 2011; Shan et al., 2013; Gustafsson et al., 2017).

Shan et al. (2013) reported a significant increase in the prevalence of cervical pain with the use of mobile phones for more than two hours a day. According to the authors of the study the increase of cervical pain with mobile phone usage was primarily due to the posture and eye-to-screen distance while using mobile phones. Again, the study points to the gravitational demand on the long cervical extensors as with poor posture and short eye- to-screen distance more cervical flexion will occur, leading to fatigue of musculature. The study done by Gustafsson et al. (2017) found a significant association (odds ratio=1.3-2.0) between cervical pain and on-going upper extremity pain and texting. However, the association between texting and the relevant symptoms seemed to have only short- term and not long-term effects.

There is some evidence from the findings that the results of the current study confirm those of previous studies. The use of IT in a home environment can be a possible contributing factor to cervical pain due to the posture learners take on when sitting or lying on different chairs and surfaces.

The results discussed up to this point are all in line with previous, existing literature and adds to the pool of knowledge available. Not only did the current study investigate the association between cervical pain and previously investigated factors contributing to cervical pain but also the association between cervical pain and scapula and cervical dyskinesis. The current study is the first of its kind to explore dyskinesis in adolescents. This unique contribution of the study will now be discussed.

5.4 SCAPULA AND CERVICAL DYSKINESIS

The matter of dyskinesis is more than just poor movement. The long-term implication of dyskinesis is the potential development of pain in the area. Dyskinesis/ uncontrolled movement is ‘not just posture or the initiation of function, but the lack of ability to actively control or prevent movement’. (Comerford et al., 2012:48)

SCAPULA DYSKINESIS

Scapula dyskinesis is the inability of the scapula musculature to stabilise the scapula while producing torque for movement (Magarey and Jones, 2003). Although the scapula resting position is not part of the actual determining of the dyskinesis, the information gained from posture assessment gives an indication of the ability of the scapula stabilisers to position the scapula in a resting position to provide an optimal length-tension relationship.

A high percentage of the learners (84.5%) presented with non-ideal upper quadrant position. The scapular resting position was compared to the skeletal position and body landmarks. The majority of the subjects presented with scapula elevation (73% left, 71% right). The spina of the scapula was higher than the T3 level, indicating that the scapula is in elevation or scapula downward rotation in the resting position or arm by the side.

This study found that 70 of 123 learners (57%) presented with scapula dyskinesis. There was no significant association between the upper quadrant position and the SDT, however, there was a marginal statistically significant association (p=0.075) between cervical posture and the SDT. This implies that the poor cervical posture has more of an effect on the SDT than scapula position itself. A forward head posture will lead to lengthening of the long cervical extensors and increased activation of the rhomboid and levator scapulae muscles to compensate for cervical posture (Thigpen et al., 2010; Helgadottir et al., 2011). This will lead to dyskinesis at the scapula.

There was no significant association between a positive scapula dyskinesis test and cervical pain. Even though there is no significant association with cervical pain, it is important to note the implication of the presence of dyskinesis in the young learners of the study. The long-term effect of poor motor control is the potential increase in the presence of cervical pain. This will be discussed in depth under section 5.5.

Only one other study assessed scapula control in children. Scapula control was measured using the Kinetic Medial Rotation Test (KMRT) (Struyf et al., 2011). A total of 19% of all learners presented with a positive dyskinesis test.

However, the results of the Kinetic Medial Rotation Test (KMRT) cannot be compared to the Scapula Dyskinesis Test (SDT) for the following reasons. Firstly, the KMRT was performed in a stable position with the patient lying on a bed compared to the SDT test that was performed in standing, an unstable position for the scapula. Secondly, in the supine position the scapula gets proprioceptive feedback from the surface the subject is lying on where the standing position gives no proprioceptive feedback to the scapula thoracic area. And thirdly, the KMRT is a non-functional test compared to the SDT. The patient has to perform glenohumeral medial rotation in a 90º abducted position while the therapist palpates the humeral head and coracoid process and feels for movement.

The study by Struyf et al. (2011) did not compare the results of the KMRT to cervical pain. Therefore the current study is the only study, to the knowledge of the researcher that compares scapula dyskinesis and cervical pain in adolescents.

CERVICAL DYSKINESIS

Cervical dyskinesis is the inability to control the position of the cervical spine while moving the shoulders or thoracic spine (Comerford et al., 2012). Although cervical posture is not part of the determining of dyskinesis, the information gained from posture assessment gives an indication of the ability of the cervical stabilisers to position the cervical spine.

There was no association between non-ideal cervical posture and cervical pain (p=0.657). The finding of no association between posture and cervical pain correlates with those of Hellstenius (2009) and Straker et al.(2009, 2011). In contrast, there were a few studies that found a correlation of cervical pain with non-ideal cervical posture but those studies looked at prolonged cervical posture in sitting (Falla et al., 2004; Straker et al., 2009; HelgadoTTir et al., 2010). The current study did not evaluate cervical posture in prolonged seated positions.

A total of 76 subjects did not have cervical control with the OALT. Even though there was no statistically significant association between cervical pain (today n=10; last week n=21; last three months n=28) and the uncontrolled OALT, the percentage of learners presenting with poor cervical control was more than 62%. This is a high percentage of learners and the long-term effects of poor control has the potential to develop pain in the area (Comerford et al., 2012). No other studies have been done in adolescents assessing cervical dyskinesis.

5.5 DYSKINESIS DISCUSSION

Scapula dyskinesis was observed in 57% of the learners and cervical dyskinesis in 62% of the learners.

Joint and muscle control in the body is of utmost importance to get optimal function-control and strength of muscles. Upper quadrant (cervical and scapular) function is optimal when the scapular and cervical muscles work together, creating a stable basis at the cervical spine and shoulder girdle for the generation of strength. Muscles can be classified according to the stabiliser/ mobiliser function they have. Stabiliser muscles are normally part of the local muscle system, the deepest layer of muscles, maintaining and controlling the spinal curvature, controlling/ preventing translation of a joint, working in all ranges, all direction and during all functional activities. Mobiliser muscles are normally part of the global muscle system, the superficial or outer layer of muscles, can respond to changes in line of action and load, provides strength, it produces range and controls the range. (Arokoski, Valta, Airaksinen and Kankaanpää, 2001; Marieb, 2004; Anderson and Behm, 2005; Comerford et al., 2012)

Motor recruitment during function depends on the type of motor units innervating specific muscles. Two types of motor units exist; slow-low threshold motor units and fast-high threshold motor units. Muscles innervated with mainly the slow motor units recruit first. These muscle fibres are rich in myoglobin content and capillary beds, and are therefore resistant to fatigue. The slow motor units are important for local stability, and sustaining muscle contracture for control and posture. The fast motor neurons innervate large muscles, generating more force. These are generally the muscles of the global system. The fast motor units fatigue faster than the slow motor units despite generating more force. (Purves, Augustine, Fitzpatrick, Hall, LaMantia, McNamara et al., 2008)

With movement, the local stability muscles must recruit before the global muscles contract. This sequence of recruitment ensures good joint alignment, creating a stable base allowing the force generating global muscles to contract optimally (Ferguson, Marras, Burr, Davis and Gupta, 2004; Comerford et al., 2012).

Dyskinesis is the result of delayed muscle recruitment of the local stabilisers as well as the lack of movement control of the global stabilisers. The global mobiliser muscle system attempts to take over the function due to the altered sequence of recruitment. The force generating global muscle system now has to contract for long sustained periods and this leads to muscle spasm due to overexertion and fatigue of the fast motor unit muscles. The global muscle system recruits earlier than the local system leading to extended periods of recruitment and fatigue of the muscles. (Falla et al., 2004; Comerford et al., 2012; Worsley, Warner, Mottram, Gadola, Veeger, Hermens et al., 2013; Celenay, Kaya and Akbayrak, 2016)

One reason for the lack of association between dyskinesis and cervical pain in the current study could be the presence of compensating strategies to maintain function. Substitution strategies are used to compensate for any joint restriction, postural strain, trauma or muscle weakness/tightness, delaying the onset of pain (Comerford et al., 2012). In Figure 5.1 the progress of restriction leading to pain is depicted. Restriction, of any nature, leads to compensation of the body and that leads to uncontrolled movement. Uncontrolled movement is movement that takes place with excessive joint translation due to failure of adequate segmental control due to lack of local stability. This leads to altered timing of stability and mobility muscles and to altered patterns of recruitment (Comerford and Mottram, 2001). Uncontrolled movement occurs that leads to pathology and ultimately pain.

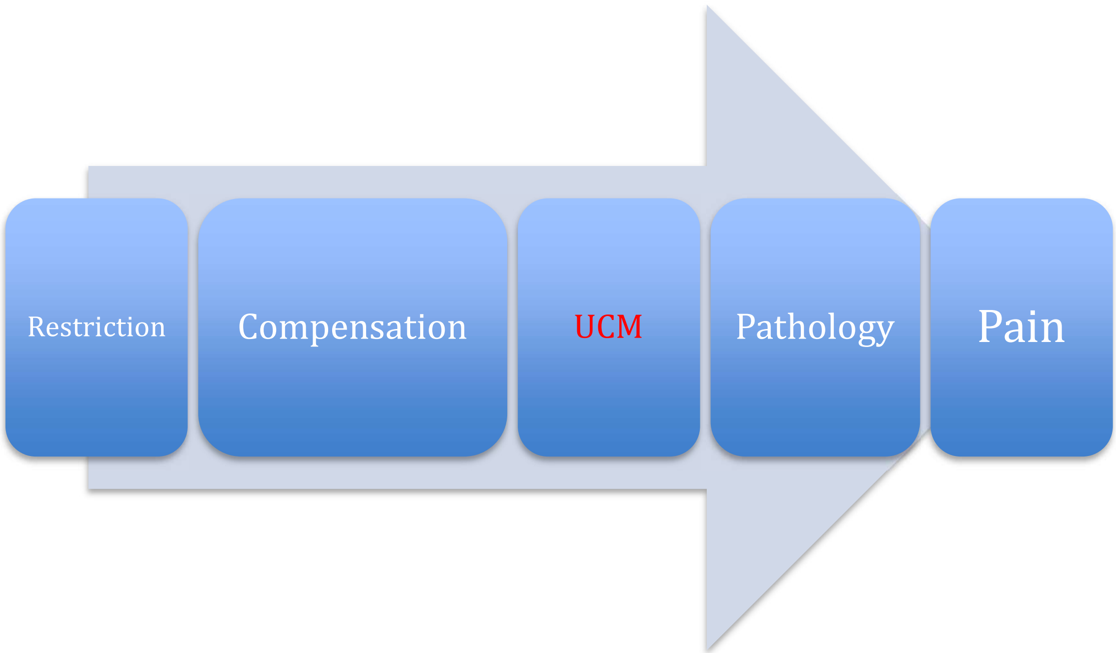


Figure 5.1 Process of restriction leading to pain (Comerford et al., 2012:49)

Learners in Grade 7 still have controlled exposure to sitting and IT usage. When exposed for longer periods of time to sitting and IT an association between cervical pain and sitting and the use of IT is evident (Brink et al., 2015). The research shows that there is a statistically significant association ($p=0.004$) between the duration of use of IT at home and the frequency of cervical pain. There is also a statistically significant association ($p=0.009$) between the duration of recreational IT usage and cervical pain on the day of data collection. All these activities took place in a sitting position. Smith and colleagues (2009) found an association between sitting for 50-60 hours per week and cervical pain in boys and 60-70 hours per week in girls. The prolonged hours of sitting can lead to fatigue of the global stability cervical muscles, with overuse of the global mobilisers resulting in pain, indicating a possible association between cervical pain and dyskinesis.

There are two possible explanations for cervical pain in the learners. Firstly, the theory of compensating strategies can be applied as one way to explain why the learners only had an association with pain after a higher number of sitting hours. In a study by Falla et al. (2004) a repetitive upper limb task was performed by subjects with and without cervical pain. The study found an increase in the muscle activity of the superficial cervical muscles (global mobilisers), including the sternocleidomastoid, anterior scalene and upper fibres of the trapezius muscles in the subjects with cervical pain. As the muscle activity was tested in a seated position with the subjects performing repetitive tasks it can be argued that the same will be happening in the muscles of the children who develop pain after sitting for extended periods of time. The long periods of sitting can lead to fatigue of the postural muscles (local stabilisers) with the global muscles compensating for the lack of stability. The increase of activity in the global muscles over a period of time can lead to pain due to muscle spasm which could in return cause more activity in the global muscles (superficial muscles).

A second way to interpret the presence of dyskinesis but the lack of association with cervical pain can be through pain neurophysiology. Changes in neural mechanisms are associated with movement changes in individuals with pain (Nijs, Van Houdenhove and Oostendorp, 2010). In the presence of pain. motor cortex smudging takes place (Nijs, Meeus, Cagnie, Roussel, Dolphens, Van Oosterwijck et al., 2014). Motor cortex smudging is strongly associated with a high severity of pain in the lumbar area. With motor cortex smudging the control of the movement is affected due to the neurophysiological tract pathways. In a study done by Schabrun, Elgueta-Cancino and Hodges (2017) motor cortical organisation (mapping) was done using transcranial magnetic stimulation. In the healthy individuals there were two distinct areas of activation in the motor cortex (deep multifidus and longissimus) whereas in individuals with moderate to high severity of pain there was overlapping and only one area of activation. This phenomenon is called motor cortex smudging. Muscle function of the cervical erector spinae muscles is the same as those of the lumbar erector spinae (longissimus and multifidus) so the phenomenon can be applied to the cervical area (Norkin and Levangie, 1992).

The clinical implication is that there will be an increase of muscle activation in the cervical area due to motor cortex smudging. This in turn leads to altered muscle activation patterns that lead to abnormal patterns of muscle activation. The joint is exposed to extra strain and could be putting pressure on the surrounding structures that are innervated with nociceptors, that can lead to poor movement and ultimately to pain. This can be seen where non-physical factors like stress, sex and the perception of schoolbag weight, has an association with cervical pain and therefore can lead to poor movement. In the current study associations with headaches, perceived weight of schoolbags and sex can contribute to the theory of motor cortex smudging. Motor cortex smudging will lead to poor movement and dyskinesis in the painful area.

The theories of neural mechanisms and muscle control can be seen as two sides of the same coin. On the one hand poor position and movement (uncontrolled movement) can lead to an increased load on the joints and lead to altered muscle recruitment patterns, as the slow motor units have an altered recruitment pattern (Comerford et al., 2012). On the other hand, moderate to high levels of pain, not the pathology as such but rather the presence of pain, can lead to motor cortex smudging that can in turn lead to altered muscle activation and movement (Schabrun et al., 2017). Pain due to stress, sex and emotional problems could lead to motor cortex changes that lead to motor cortex smudging that have a direct effect on muscle function.

From the current study it is concluded that the presence of cervical pain, and scapula and cervical dyskinesis, exists in Grade 7 learners in Tshwane, Gauteng, South Africa. The unique contribution of this study can be explained using two different approaches.

Observing the factors that contribute to cervical pain it is clear that seated positions combined with the use of IT have statistically significant associations ($p=0.004$, $p=0.009$, $p=0.018$) with cervical pain. This links with the theory of movement control according to which prolonged periods of sitting will lead to fatigue of the long cervical extensors (global stabilisers) and the over activity of the superficial cervical muscles (global mobilisers). This could lead to increased strain on the cervical joints, with the potential of leading to joint dysfunction and ultimately more pain.

On the other hand, the psychosocial factors that have a statistically significant correlation with cervical pain will have an indirect effect on movement control through motor cortex smudging. Non-physical factors contributing to cervical pain will have an effect in the motor cortex where smudging of the stability muscle recruitment will take place. This will lead to a change in muscle control with global stabilisers and mobilisers over activity. In return, this can lead to muscle fatigue and strain on relevant joints, and once again, potentially leading to joint dysfunction and more pain.

Both approaches can explain the high percentage of scapula and cervical dyskinesis that is present amongst the Grade 7 learners. Even though there is no significant association between cervical pain and scapula and cervical dyskinesis this could potentially lead to a vicious cycle of movement dysfunction and pain. This vicious cycle of movement dysfunction and pain could also be an explanation for the increase in cervical pain with age. Compensatory mechanisms can be present in learners with dyskinesis without cervical pain. But as time goes on, the compensatory mechanisms might be insufficient or start failing, and that can lead to the presentation of cervical pain. This is a gap in the literature that has no explanation for the increase in incidence in cervical pain in adolescents and for which a reason can be found in the current study. No studies have been done assessing motor cortex smudging in children. The implications of the findings of this study are far reaching, addressing an aspect of cervical pain that has not been studied by looking at the dynamic control of the cervical spine and scapula.

In Chapter 6 the limitations and the recommendations of the study are discussed.

CHAPTER SIX

6. LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

In reflection, certain limitations were evident in the study. The limitations of the study are stated in this chapter. Specific recommendations are also made based on the important findings from the study. These recommendations are for further research and the application of the new knowledge from the study.

6.2 LIMITATIONS OF THE STUDY

The limitations of the study were retrospectively observed. Firstly, not enough information was given by learners about the type of IT used at school and home for educational activities. The literature study pointed out that the type of device used, e.g. laptop, computer or electronic tablet device, has different effects on the outcome of cervical pain and can have an influence on the report of cervical pain. One significant association was between the usage of IT for homework and cervical pain. The study does not discuss the type of device.

Secondly, the position the learner assumed during seated activities was not clarified in the study and is a limitation. It is difficult to draw conclusions from the data about sitting positions due to the learners not specifying their position during seated activities.

Thirdly, the study was only conducted in private schools. Unfortunately the Gauteng Department of Education changed their policy regarding research in schools and the study could not be done in government schools.

6.3 RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

Firstly, the repetition of the current study in government schools in Tshwane to include a larger study population. A large survey to determine the prevalence of cervical pain in learners will give insight into regional prevalence of cervical pain. Suitable recommendations to education and health authorities will carry more weight. Furthermore, the repetition of the current study in rural areas in South Africa to determine possible differences due to socio-economic, cultural and home environmental differences.

Secondly, one can argue that the home environment is not specified and controlled for each learner and therefore the participants might not have been in an ergonomically suitable position. Therefore in a follow-up longitudinal study the home environment should also be taken into consideration.

The next recommendation is, thirdly, the assessment of dyskinesis in seated postures. Dyskinesis was assessed in standing positions but seated positions are assumed more during school hours and when doing homework. Therefore the assessment of dyskinesis in a seated position will reveal functional dyskinesis in the position.

Fourthly, further research to assess the effect of retraining of muscle and joint control of the scapula and cervical spine on cervical pain in adolescents. As the long-term effect of dyskinesis could potentially lead to pain, a longitudinal study to assess the effects of stability muscle retraining could shed important light on the potential effect on cervical pain.

The last recommendation is further research to assess the effect of pain neurophysiology education on cervical pain in adolescents. As psychosocial factors have proven to contribute significantly to cervical pain in adolescents, addressing of the relevant factors through pain neurophysiology education could potentially make a difference to cervical pain.

6.4 CONCLUSION

There are definite limitations to the study that had an effect on the interpretation of data, limiting conclusions and limiting the application of results.

From the study numerous recommendations are made for further research into the prevalence of cervical pain also including additional intervention studies to address cervical pain in learners.

In Chapter 7 the conclusion of the study is provided.

CHAPTER SEVEN

7. CONCLUSION

7.1 INTRODUCTION

In this final chapter the conclusion of the study is provided. The problem statement, aims of the study and significant findings are highlighted. The chapter will conclude the study, highlighting the study's contribution to the profession of physiotherapy, both academically and clinically.

Based on existing, currently available literature, the study set out to explore an association of cervical pain with scapula and cervical dyskinesis and its possible link in adolescents. It was originally thought that adolescents would present with dyskinesis and an association of the dyskinesis with cervical pain would be present.

7.2 PROBLEM SETTING

Cervical pain is a common musculoskeletal condition that starts as early as adolescence and continues on into adulthood (El-Metwally et al., 2004; Aartun et al., 2014). Cervical pain in the adolescent population is present worldwide and affects between 18-40% of all adolescents (Diepenmaat et al., 2006; Aartun et al., 2014; Shan et al., 2014). Contributing factors to cervical pain vary from sex, an increase in age, emotional and psychological problems to sustained seated positions and sitting posture, the use of information technology and the perception of schoolbag weight and sleep (Diepenmaat et al., 2006; Haselgrove et al., 2008; Brink et al., 2009a; Straker et al., 2009; Straker et al., 2011; Brink et al., 2015).

An association between cervical pain and scapula as well as cervical dyskinesis has been seen in the adult population (Falla et al., 2004; Zabihhosseinian, Holmes, Howarth, Ferguson and Murphy, 2017). The treatment of the dyskinesis in adults led to a significant decrease in cervical pain (Andersen et al., 2014).

A possible association between scapula and cervical dyskinesis and cervical pain in adolescents has not been explored. Furthermore, limited literature is available about the presence of cervical pain in South African adolescents (Smith et al., 2009).

7.3 PURPOSE OF THE STUDY

The purpose of this study was twofold; firstly, it was to determine the presence of cervical pain in Grade 7 learners in private schools in Tshwane, Gauteng, South Africa. Secondly, it was to determine the association of cervical pain with scapula and cervical dyskinesis in the Grade 7 participants.

Four private schools in the greater Tshwane took part in the study with a total of 123 learners participating. The learners were all in Grade 7 with the mean age of 12.97 years. The data collection took place at the various schools in October and November 2016. The participating learners completed a questionnaire on cervical pain and questions on certain previously determined factors related to cervical pain. Two movement tests were used to determine scapula and cervical dyskinesis.

The primary objective (the association between cervical pain and scapula and cervical dyskinesis) was assessed using a multivariable logistic regression analysis. Significant associations as well as odd ratios were determined between cervical pain and various factors. Scapula and cervical dyskinesis were compared with cervical pain using ANOVA.

7.4 FINDINGS OF THE STUDY

The research indicated that 21% of all learners presented with cervical pain on the day of data collection. There was an increase in the presence of cervical pain reported in the previous week and previous three months in the learners. A high odds ratio was found with findings suggesting that 77% of the participants with cervical pain on the day of assessment also had pain in the previous 3 months.

Significantly more girls than boys presented with cervical pain. As in previous studies, the current study also showed an increase in cervical pain with an increase in age. Significant associations were found between cervical pain and related factors. The study showed significant associations between cervical pain and headaches as well as several seated activities. Seated activities include using information technology (IT) for homework, recreational use of IT and playing TV games. The increased duration of mobile phone usage also had a significant association with cervical pain.

A high percentage of learners presented with scapula and cervical dyskinesis. However, the study did not find any association between cervical pain and scapula and cervical dyskinesis.

7.5 SIGNIFICANCE OF THE STUDY

The associations found in the study between cervical pain and specific factors support the findings from previous literature regarding the presence of pain in adolescents. From the literature study the conclusion can be drawn that psychosocial factors play a more significant role in the prevalence of cervical pain in adolescents compared to physical factors. In this study the psychosocial factors that were assessed were headaches and perceived weight of schoolbags and these factors were found to have a significant or marginally significant association with cervical pain. Four seated activities were found to have a significant association with cervical pain. All four activities involved the use of IT.

Even though there was no association found between scapula and cervical dyskinesis and cervical pain, the impact of the high prevalence of dyskinesis is worth considering regarding the increased incidence of cervical pain in adolescence. Theories of muscle control support the argument that the presence of dyskinesis can lead to pain in the long run. Though learners with dyskinesis do not have pain at the moment, one can argue that sufficient compensatory strategies are in place to prevent pain. As learners are more exposed to activities that could potentially contribute to muscle fatigue and strain, like the use of IT at home, one could expect an increase in cervical pain due to insufficient coping mechanisms.

Another contributing mechanism to consider is the effect of pain on muscle control when looking at pain neurophysiology. Pain due to contributing factors, physical or non-physical, can lead to a change in neurophysiology. The inhibition of the deep stability muscles and activation of mobilising muscles can potentially take place in the presence of pain. So, even when the contributing factor to cervical pain is non-physical it can still have an effect on muscle control in the surrounding area.

Both theories, muscle control and pain neurophysiology, play important roles when assessing cervical pain and dyskinesis in adolescents.

7.6 CONTRIBUTION TO THE PROFESSION

As cervical pain is the fourth largest contributor to recurrent pain (Murray et al., 2013) it is important to address cervical pain in adolescents with the aim to reduce the prevalence and incidence of cervical pain.

<u>Professional contribution</u>

The study merges two aspects of physiotherapy by combining the theory of movement control with pain neurophysiology. This has the benefit of seeing the patient holistically and combining two approaches in physiotherapy that seems to contradict one another.

<u>Clinical contribution</u>

It is evident from the potential long-term effects regarding the impact of cervical and scapula dyskinesis that there is a benefit to add the assessment of dynamic control of the cervical spine and scapula control when assessing adolescents with cervical pain.

Contribution to the study population

It will benefit adolescents to be educated on ergonomics and the use of IT equipment and its related contribution to cervical pain.

An exercise programme to address cervical and scapula stability added to physical education at school will also benefit the learners.

7.7 CONCLUSION

The study succeeded in highlighting the presence of cervical pain in adolescents. It is evident that a significant percentage of Grade 7 learners suffer with cervical pain. There is also evidence that a high percentage of learners presented with scapula and cervical dyskinesis. Therefore it is important to address cervical pain and the long-term potential that the presence of scapular and cervical dyskinesis could have on cervical pain.

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Annexure A

Table with critical appraisal of literature

Study and aims of study	Methodology and setting	Outcome measures used	Factors assessed	Findings	Critical analysis
Feldman et al. (2002) To investigate the cumulative occurrence of neck and upper limb (upper back, shoulder and arm) pain over a period of one year as well as associating factors Grade 7-9 (ages 12-15) in Montreal, Canada	Prospective study design with cohort followed over 12 months n=502 Canada **Setting:** Data was collected in school setting, three times over a 12 month period, every six months	Self-administered questionnaire addressing lifestyle and musculoskeletal health. Questions included sports participation, music involvement, occupational activity (work/job related). (No validity/reliability available) Mental health status was determined by the 5-item Mental Health Index from the MOS 36-Item Short-Form Health Survey (SF-36) Their height and weight also were measured during physical education class.	Incidence of cervical and upper limb pain. (Presence of pain at least once a week)	1st six months: 19,9% increase in neck and upper limb pain 2nd six months: 13,3% increase 28,4% cumulative incidence of Neck and upper limb pain in one year period	The population is the same age group as this current study. The study is more than 15 years old but the findings correlate with those in more recent literature, confirming the tendency that cervical pain is more related to non-physical problems than physical exposures.
			Sports participation	No significant association with NULP OR (95% CI): 1.00 (0.99,1.01)	
			Music involvement	No significant association with NULP OR (95%CI): 0.80 (0.40,1.59)	
			Occupational activity (Work)	Significant association with NULP OR (95%CI): 1.89 (1.11, 3.21)	
			Mental health	Significant association with cervical and upper limb pain (95%CI): 1.68 (1.19,2.00)	
Murphy et al. (2004) To determine the association between sitting posture and cervical and lumbar pain	Cross sectional study design with opportunistic sample taken from a larger group (679) n=66 England, UK	1. Portable Ergonomic Observation Method (PEO), recorded for 30 min/ child 2. Measurements of height and weight	Prevalence of Self-reported pain	High percentage of participants reported MSK in last month and last week. Cervical pain last month 34/66 (51%), cervical pain last week 16/66 (24%) but only 4,5% of neck pain	This study's population is not a true reflection of population as opportunistic sample was used. Small sample size used. No relation found between posture and pain.

11-14 year olds	**Setting:** Classroom set-up with posture recording for 30 min per child. Portable Economic Observation method (PEO) was used for recordings. Posture recording started 10 min into the class. Learners were only informed afterwards that their posture was recorded. Afterwards a health and lifestyle questionnaire was completed.	included 3. Health and lifestyle questionnaire, including Nordic, Musculoskeletal Disorders Questionnaire		sufferers sought medical help	Validated measuring tool used leading to question the large variations found. Low degrees of trunk flexion associated with cervical pain- argument that increased cervical flexion could be to compensate for lack of trunk flexion.
			Percentage of time spent in posture	PEO measurement: Mean cervical flexion: >20º= 34% of time 38% of time spent working at a desk	
			Number of movements	PEO measurement: large variations With 20-45º trunk flexion: 21 movements With >20º cervical flexion: 42 movements	
			Cervical pain and associated factors	Taller children reported more cervical pain (p=0.025) Low number of trunk flexion (PEO measurement) associated with cervical pain in last week (p=0.047)	
Puckree et al. (2004) -To determine the relationship between cervical, lumbar and/ or shoulder pain and schoolbag carriage Ages: 11- to 14-year olds	Cross-sectional study n=176 South Africa **Setting:** Questionnaires were completed at school. Grade 7 learners from 4 primary schools in Kwazulu-Natal (KZN) completed the questionnaires	Self-developed questionnaire (tested in pilot study) about demographic information, medical history and questions regarding schoolbag carriage and pain.	Neck, shoulder and/or back pain	A total of 86.9% of all learners reported pain	A very high proportion of learners complained of pain but study doesn't specify the specific site or intensity.
			Gender	Girls had more pain than boys (p<0.01)	
			Schoolbag weight .	Learners divided into schoolbag weight <10% or >10% of their body weight More pain in <10% group.	
			School bag carriage	Pain association with carriage of bag on both shoulders (p=0.00)	
Diepenmaat et al. (2006) To assess the prevalence of cervical/shoulder, low	Cross sectional study design n=3485 Holland	Self- reported questionnaire. Questions: Physical factors	Prevalence	Neck/shoulder pain: 11,5%	The study has a large sample size. The sample size included learners from all different backgrounds and ethnic origins.
			Gender	Girls presented with 63% more cervical pain than boys odds ratio [OR]: 1.4 95% confidence interval [CI]: 1.2–	

back and arm pain in adolescents in Holland. To determine the association of above-determined pain with computer use, physical activity, depression and stress. 12-16 year olds	**<u>Setting:</u>** Self-reported questionnaires were completed in classrooms at secondary schools in Amsterdam	(computer use physical activity, physical inactivity). Depression: using Center of Epidemiologic Studies Depressive Scale (CES-D)- validated questionnaire Socio-demographic information (gender, education, ethnicity)		1.8;	No physical tests were performed to confirm the presence of pain as all the information was gathered from a self- reported questionnaire. Study correlates with data that physical activity has no effect on neck pain.
			Computer use	No significant association found	
			Stress	Associated with cervical pain OR: 2.0; 95% CI: 1.5–2.7	
			Depression	Cx pain associated with depression OR: 1.9; 95% CI: 1.5–2.5	
			Physical activity/inactivity	No significant association found	
Auvinen et al. (2007) To determine if physical activities and sedentary activities had an association with cervical and shoulder pain in adolescents 15-16 year olds	Cross- sectional study design n= 5993 **<u>Setting:</u>** <u>A postal questionnaire was used to gather information</u>	Postal questionnaire in 2001/2002 Self reported questions about prevalence of Cervical pain (NP) and shoulder pain (SP) Physical activity questions and 2/52 later re-tested to assess reliability	Sex	<u>In 16y olds:</u> Girls: Cervical pain: 45.2% Consultation for cervical pain: 4.2% Boys: Cervical pain: 32.7% Consultation for cervical pain: 1.5%	Large sample size Neck and shoulder pain were assessed separately and not as one unit as done in current study Limitations (also mentioned in study): self reporting of pain, activities and sitting time. Might be over reporting physical activity, as it is socially desirable.
			Physical activities and cervical pain	Increase in consultation for cervical pain in girls with increasing level of activity but not statistically significant No association of activities with cervical in boys	
			Sedentary activities and cervical pain (NP)	Sitting 4-7.9hrs after school associated with consultation for NP in girls (OR 1.2, 95% CI 1.0-1.4) Sitting 8 hr+/ day associated with NP and consultation for NP in girls and boys. Activities: girls watching TV 2hrs+ (OR 2.3; 95%CI 1.1-5.0) Boys watching TV1-2hrs reporting NP (OR 1.4; 95%CI	

				1.1-1.7) consultation for NP (OR 2.4; 95% CI 1.2-5.0) Reading books: girls, NP (OR 1.4; 95% CI 1.0-1.8) consultation for NP (OR 2.1; 95% CI 1.0-4.2). Computer time for boys reporting and consulting for NP (OR 1.3; 95% CI 1.0-1.7)	
Breen et al. (2007) -To determine children's posture and discomfort during computer use mean age: 9.5 years	Cross-sectional study n= 68 England, United Kingdom **<u>Setting:</u>** Observation of posture during computer sessions of 15-25 minutes	RULA: Rapid upper limb assessment (Action levels determined) BDC: body discomfort chart VAS: Visual analogue scale	Musculoskeletal pain	16% of participants reported cervical pain a further 12% developed pain while using the computer	Observational study with focus on the RULA (objective outcome measures) that determined posture. Observation time short- 15 to 25 min.
			Postural changes during use of computer	No difference from beginning to end of observation	
El-Metwally et al. (2007b) To determine risk factors for the development of non- specific musculoskeletal pain in preteens and young adults. Mean age: Third graders: 9,8 years old Fifth graders: 11,8 years old	Prospective one year study design with follow-up study longitudinal cross-sectional design n=1756 Finland **<u>Setting:</u>** Questionnaires were completed at participating schools (19). A trained school nurse did the hypermobility test in a classroom at schools.	1. Pain questionnaire designed by authors of study 2. Hypermobility test- Beighton's method (score 0-9)	Incidence of MSK (musculoskeletal pain)	An incidence of 21,5% of new MSK pain was reported at 1-year follow-up in pain free baseline participants. 4% reported as traumatic pain and 19% as non-traumatic. Most non-traumatic pain in the cervical area	This study, even though 10 years old, the data is still very relevant. The sample size is sufficient for the predictability of MSK and this study is referenced in many studies that were done much later. The age group is slightly younger than the current study but as pain increases with age (seen in other articles), this is a very relevant study to include. This is one of the only studies that correlates pain with levels of exercise
			Psychosomatic symptoms (headache, abdominal pain, feeling sad/down, difficulty falling asleep, day- time tiredness, waking up during night)	All psychosomatic symptoms were predictive risk factors to non-traumatic pain: Significant: headache (OR=1.68), daytime tiredness (OR= 1.53), borderline: female gender (OR=1.39), difficulty falling asleep (OR= 1.48). Traumatic pain:	

				Day-time tiredness (OR= 2.97) significant role Females had 40% higher risk than males to experience cervical pain	
			Hypermobility	Hypermobility was not associated with an increased risk in non-traumatic or traumatic MSK	
			Exercise	Vigorous exercise (OR=3.4) was identified as a risk predictor for traumatic pain.	
Murphy et al. (2007) To identify the associations between back and neck pain with physical and psychological risk factors Ages: 11-14 years, mean age 12.8	Cross-sectional study design n= 697 England, UK **Setting:** Classrooms of state secondary schools in Surrey, England.	1. Self-reported questionnaire 2. Strengths and difficulties questionnaire for psychological difficulties (SDQ) 3. Measurements of body height and weight (BMI determined) 4. Weight of school bag was measured	Prevalence of neck pain, upper back and low back pain	Pain reported for 1 day or more in previous month: 27% neck pain 18% upper back pain 13% lower back pain	Data quite old, but good sample size for data collection. Physical measurements done, not only questionnaires given
			Psychological difficulties	Associations found between: current pain and previous pain experience (p=0.01); family member with lower back pain and Cx and Lx pain (p=0.01); previous treatment for MSK pain and Cx and Lx pain (p=0.000); back pain and emotional problems (p=0.02)	
			Sport and physical activity	No significant relationship between activity and pain	
			Chair features	Of physical factors assessed the strongest association with pain. Low chair height significantly associated with all spinal pain (Cx, Tx and Lx) OR= 2.18, p<0,005	
			School bag weight	Findings inconclusive	
			Common childhood	Strong association between	

			complaints: headache, sore throats, stomach aches	cervical pain and headache (OR=2.4, p<0.001) Association between sore throat and lower back pain (OR=2.11, p<0.001)	
Haselgrove et al. (2008) -To determine a possible relation between the use and perceived load of schoolbags and presence of spinal pain. -To determine if a difference in gender is significant with regard to use and perceived load of schoolbags and presence of spinal pain. -To determine if duration of use of schoolbags is related to perceived load of schoolbags Mean age 14.1	Cross- sectional epidemiological survey n=1202 Australia **Setting:** Western Australian Pregnancy Cohort (Raine) Study. All members of cohort were invite to participate. Questionnaire was completed on a laptop with help of research assistants. Study did not disclose where the questionnaire was completed.	Questionnaire with 130 multiple choice questions regarding use and perceived weight of schoolbag as well as spinal pain	School bag load	50 % of participants reported spinal pain before or currently with carrying of schoolbag. Significant relation between perceived weight and perceived fatigue (p<0.001)	Large sample size with reliable findings. School bag load questions show that the subjective perceived heaviness and not the actual weight is related to pain. Study indicates that females experience more cervical pain.
			Gender	More females than males perceived school bag weight to be heavy (OR 2.16, 95% CI 1.71-2.73)	
			Duration carrying bag	Almost 50% of participants carry school bags for more than 30min/day	
Mikkelsson et al. (2008) To determine onset, prognosis and risk factors for wide spread musculoskeletal pain in school children Mean age: 9,8 Third graders 11.8 Fifth graders	Prospective study with 4 year follow –up n= 1756, follow-up 1282 Finland **Setting:** Questionnaires were completed at participating schools (19). A trained school nurse did the hypermobility test in a classroom at schools	Questionnaire about widespread somatic pain and musculoskeletal pain the last 3 months, follow-up questionnaire at 1-year and 4-years later. **Widespread somatic pain (WSP)** classified as presence of contralateral pain in 2 quadrants as well as spinal pain Hypermobility test at school (6/9+ on Beighton	Prevalence and incidence of WSP (widespread somatic pain	New incidence of WSP: 7% at 1y follow-up 14% at 4y follow-up 18% at either 1y or 4y and 3% at both 1y and 4y follow-up	Old data even though only published in 2008. One of the first studies done on musculoskeletal pain with follow-up to determine prognosis and incidence of MSK pain. This study focused on wide spread musculoskeletal pain and not only on cervical pain but cervical pain is a. independent risk factor to developing WSP. Large sample size
			Prognosis of WSP	Of participants with WSP at baseline 31% reported recurrent/persistent WSP at 1y follow-up and 30% reported recurrent/persistent WSP at 4 y follow-up. Of new onset WSP at 1y follow-up 37% reported WSP	

		score was noted as hypermobile)		at 4y follow-up	
			Musculoskeletal pain changes at follow-up	Of **pain free** children at baseline: 9% developed WSP, 25% remained pain free and 65% developed regional MSP symptoms	
			Risk factors for WSP	Independent baseline predictors of new-onset WSP: Age >11 years (OR 1.3 95% CI 1.0–1.8) Female gender (OR 1.4 95%CI 1.1–1.9), Feeling sad or down (OR 1.5 95% CI 1.1–2.2) Regional back pain: --Neck pain (OR 1.7 95% CI 1.1–2.4), -Upper back pain (OR 2.1 95% CI 1.1–4.1) -Lower back pain (OR 3.0 95%CI 1.6–5.7)]. Vigorous exercise and hypermobility did not predict the development of WSP in children	
Ståhl et al. (2008) -To determine prognosis and risk factors for the occurrence and persistence of non-specific cervical pain in school children 9-12 year olds	Prospective study with one and four year follow-up n= 1756 (follow-up 1268) Finland **<u>Setting:</u>** Questionnaires were completed at 19 participating schools. A trained school nurse did	Pain questionnaire regarding cervical pain was completed. (Validity and reliability were previously determined in sample of population.) Six questions for physical and psychological symptoms: headaches, abdominal pain, depressive mood,	Frequency of cervical pain	3 groups= No cervical pain (61%) Cervical pain once a month (24%) Cervical pain more than once a week (15%) One-year and four-year follow-up: p<0,0001 frequency stays the same Girls OR 5,9 for weekly cervical pain	The baseline data was done in a population younger than of the current study but the four-year follow-up is at the same age as the current study. The results of this study correlate to other studies indicating the chronicity of cervical pain, as risk of pain being present at four-

	the hypermobility test in a classroom at schools	daytime tiredness, difficulty falling asleep, waking up at night Beighton score to test hypermobility (done by school nurse)		Boys OR 4,6 for weekly cervical pain	year follow-up was high.
			Hypermobility	No association determined	
			Physical and psychological symptoms (headaches, abdominal pain, depressive mood, daytime tiredness, difficulty falling asleep, waking up at night)	Association to increase of cervical pain frequency: p<0.0001 related to headaches, abdominal pain, depressive mood, daytime tiredness, difficulty falling asleep, waking up at night	
Brink et al. (2009b) -To determine the association between postural alignment and psychosocial factors to upper quadrant pain (UQMP) in high school students. 15-17 year olds	Prospective study done over period of 6 months. N=104 South Africa **<u>Setting:</u>** Posture assessment took place in class at computers. All questionnaires were also completed in class.	Computer usage questionnaire (CUQ) to determine participants Sitting postural alignment measured by using Photographic Posture Analysis Method (PPAM) 21-item Beck Depression Inventory (BDI) for depression and 39-item Multidimensional Anxiety Scale for Children (MASC) to determine anxiety UQMP measured at 3 months and six months using the pain component of CUQ	Incidence of neck pain	14 new cases at 3 months, 13 new cases at 6 months In total 27 new cases due to computer and seated activities	The results of this study are contradictory of most of the other studies done, especially those in first world countries not finding any association with anxiety and depression. The difference could be due to the fact that high school learners in SA are from a developing country and social exposures are different due to socioeconomic circumstances. Reliable outcome measures were used but the sample size was small so that might have lead to the contradictory findings compared to majority of other studies
			Correlation between explanatory variables	Increased weight and BMI associated with shoulder protraction and flexed spinal postures. Depression: greater depression scores were related to more upright postures	
			Extreme postures associated with UQMP after six months	Students with extreme cervical angles were at risk to develop UQMP (OR 2.8 (95%CI 1.1-7.3) Boys were at greater risk than girls to develop UQMP (OR 1.9; 95%CI 0.9-4.9) although not statistically significant	
			Other explanatory variables associated with UQMP at 6 months	No statistically association with pain and anxiety, depression or computer use, or for gender subgroups	
Brink et al. (2009a) -To determine the	Prospective study done over period of 6 months. N= 104 pain free	Computer usage questionnaire (CUQ) Validity and reliability	Incidence of neck pain	27 of 104 (initially pain free) students developed neck pain over 6 months related to seated	No significant association between sitting posture at

influence of computer use on sitting posture of high school students who develop neck and shoulder pain Age: 15-17 year olds	participants determined by completing the Computer usage questionnaire (CUQ) South Africa **<u>Setting:</u>** At school, learners were performing a curriculum-specific typing task while measurements were taken through three photographs	proved. Postural alignment done with three photographs taken five min apart, using the Photographic Postural Analysis Method		activities such as computer work	computer and the incidence of neck pain in study population. Study results is suggestive that pain is not associated with physical components
			Posture over time	The greatest change in posture occurred at the cervical angle for the painful group. The change in posture over time was not statistically significant (p>0.05).	
Straker et al. (2009) To determine the relationship between prolonged cervical/ shoulder pain and sitting spinal posture in male and female adolescents. Age: 14 year olds (Prolonged cervical/ shoulder pain- pain lasting more than 3 months, including recent pain in previous month)	Follow-up at 14 years of pregnancy Cohort (Raine Study) n=1593 Australia **<u>Setting:</u>** Part of the Raine study (see Haselgrove et al. 2008). Questionnaire was completed on a laptop at the assessment center. Habitual posture analysis was done at the assessment center.	Self-completed questionnaire on laptop at assessment center. 130 questions covering physical, medical, nutritional, psychosocial and developmental issues. Physical assessment included: Habitual spinal posture during sitting Spinal sagittal posture assessed through photographic analysis of visual markers on bony landmarks. *(**Fleiss 1986 reliability and validity) Lateral photos taken of participant looking straight ahead, looking down at their lap and sitting	Prevalence of Cervical/shoulder pain	5.3% of population experienced prolonged cervical/shoulder pain. Gender difference was significant: 6.5% females vs. 4.2% males. (P=0.035)	This is a unique study as it looked at prolonged pain and not recurrent pain. 5% of participants reported prolonged pain. Findings in study similar to other studies that cervical/ upper quadrant posture is not significantly related to cervical pain. Question must be raised to why lordotic posture contributes to cervical pain?
			Posture	Gender differences: females sitting more erect and lordotic postures when looking straight ahead (p- values varying between 0.009 and 0.001)	
			Prolonged cervical/shoulder pain and posture	Adolescents with cervical/shoulder pain: - More flexed cervico-thoracic angle (p=0.028) - More extended trunk angle (p=0.048) -More lordotic lumbar angle (p=0.004) -More anterior pelvic tilt (p=0.005) Similar pattern observed with looking down and slumping	

		slumped	Prolonged cervical/shoulder pain, posture and gender	In posture when looking straight ahead both increased anterior pelvic tilt (p=0.019 OR (95%CI) 1.02 (1.00-1.03) and decreased lumbar angles p=0.014 OR (95%CI) 0.99 (0.97-1.00) are weakly predictive of prolonged cervical/shoulder pain when controlling for gender.	
Hellstenius (2009) To identify differences in cervical biomechanics in preadolescents who present with recurrent neck pain and/or headaches and asymptomatic preadolescents Ages 10-13years	Cross sectional observational study Convenience sample n= 131 Sweden **<u>Setting:</u>** Questionnaire and physical examination was done at a municipal school	Questionnaire (adapted from questionnaires found in literature investigating characteristics of headaches and neck pain) For pain: 11-point Likert scale was used Physical examination: plumb line posture, in sitting active cervical movements, palpation of cervical spine in supine for vertebrae and muscles including TPs	Cervical pain and characteristics	A discrepancy was found between the report of pain by children and by their parents. Children reported 31% cervical pain whereas their parents reported that only 6% children had cervical pain	The findings of this study correlate with other studies to show that cervical pain in children doesn't have associations with apparent mechanical dysfunction and forward head posture. The study doesn't give enough information to know how cervical joint dysfunction (CJD) was examined. A chiropractor and not a physiotherapist determined the CJD.
			Trauma:	No association between cervical pain and headaches and trauma	
			Prolonged sitting postures (2hrs+):	Reported to elicit or exacerbate cervical pain and/or headaches, especially with reading and computer use	
			Movement of neck	27% symptomatic children reported that movement elicit or exacerbate their pain	
			<u>Physical findings:</u> Forward head posture (FHP)	Even distribution of FHP, in sitting and standing, of pain free and symptomatic students. FHP not significantly associated with neck pain	
			Cervical range of motion	No statistically significant difference between pain free and symptomatic groups	
			Trigger points and muscle spasm	60% of all students presented with tight muscles. No significant association between	

				cervical pain, headaches and the presence of tight muscles	
			Cervical joint dysfunction (CJD)	No significant difference between 2 groups assessing upper and middle CJD. Significant association between right lower CJD and presence of headaches / neck pain (p=0.050)	
Smith et al. (2009) To determine the prevalence of neck pain and headaches and their associative factors including computer use Mean age of girls: 16.3 years Mean age of boys: 16.4 years	Cross-sectional study n= 1073 Western cape, South Africa **Setting:** Questionnaires were completed at the participating schools with supervision of the researcher and research assistant.	Computer usage questionnaire (CUQ) was completed in presence of principle and assistant researchers at the participating schools.	Prevalence of cervical pain and headaches	Cervical pain previous month to data collection: 20% (girls 19,6%, boys 20,1%) Both headaches and cervical pain: 7,1% (girls 7.7%, boys 5.9%)	This is the one of two known studies in South Africa to determine prevalence of cervical pain in adolescents. Although the age group is older than the current study it is very relevant as it is in the same country as current study Cervical pain and gender: data differs from majority of other studies, as it is equally present in boys and girls in this study.
			Computers use and cervical pain	The longer the hours of exposure the higher the percentage students with symptoms (no p value or OR provided)	
			Other associative factors:	Psychosocial factors: girls>boys, older students>younger students Sport: no age difference in participation in sport Girls less participation than boys	
			Headache predictors:	Gender (girls): OR (95%CI) 2.3 (1.7, 3.2) High levels of psychosocial factors OR (95%CI) 1.9 (1.3, 2.5)	
			Cervical pain predictors	>=8.5 hours of computing/ week OR (95%CI) 1.7 (1.2,2.3)	
			Predictors of Headache and neck pain occurring together	No significant predictors when combining headache and neck pain events	
Auvinen et al. (2010)	Longitudinal study, 2-year follow-up	2 questionnaires, one in 2002/3, follow-up in	Prevalence of cervical pain and gender	**Girls 16y:** 49.85% **Boys 16y:** 34.8%	Study conducted 2002/3, 15 years ago,

To determine if quality and quantity of sleep are possible risk factors for neck, shoulder and lower back pain Ages: 15-19 years old	n=1779 Finland **<u>Setting:</u>** Postal questionnaire that subject reported in own environment	2004/5		**Girls 18y:** 73.8% **Boys 18y:** 49.4% Girls reported more cervical, shoulder and lower back pain than boys (p<0.001)	so findings are old. because of the changing nature in usage of electronic hand-held devices and use of computers.
			Age	More cervical, shoulder and lower back pain reported at age 18y than 16y (p<0.001)	
			Quality of sleep	Girls reported less quality of sleep than boys: more nightmares, being tired, general sleep problems (p<0.001) Girls: 16 y old c/o tiredness associated with cervical and lower back pain at age 18 OR 3.92 (95%CI 1.55-9.90) Boys: 16y old c/o tiredness associated with shoulder pain at age 18 OR 1.57 (95%CI1.10-2.25)	
			Quantity of sleep	Boys slept more than girls (p<0.001) Girls:16y old sleeping <7hrs/night associated with NP, SP and LBP age 18 but not statistically significant. Boys: 16y old sleeping 9hr/night associated with highest prevalence of LBP.	
O'Sullivan et al. (2011a) -To determine the biopsychosocial characteristics of children with chronic non-specific musculoskeletal pain	Cross-sectional study n=60 (30 subjects with CNSMSP and 30 control subjects) Australia **<u>Setting:</u>**	Child behaviour checklist (psychosocial factors) and Youth activity questionnaire (lifestyle factors) Physical assessment of posture, back muscles endurance, joint	Psychosocial factors	CNSMSP subjects had significantly more somatic complaints (p<0.001) and anxiety/depressive symptoms (p=0.018)	Physical and non-physical findings related to CNSMSP. Could be because of the chronicity that the constant pain caused physical changes as well as emotional and
			Lifestyle factors	Significantly less physical activity participation in CNSMSP group (p=0.005)	

(CNSMSP) Ages: 7-18, mean age: 12,7 CNSMSP: pain present for more than three days per week on average for greater than three months usually associated with interference with or modification of normal function	Rheumatology out patient clinic. All CNSMP subjects were seen by a rheumatologist to clinically and radiologically rule out specific causes of chronic pain. 30 painfree subjects were also recruited- method of recruitment not disclosed.	hypermobility and gross motor skills (using McCarron Assessment of Neuromuscular development- MAND)	Spinal postures	Usual posture vs. slump posture was assessed: Significantly less difference between usual and slump posture in CNSMSP group (p=0.01), minimal difference in pelvic tilt between usual and slump sitting CNSMSP (p=0.05) Significant greater cervical flexion (p=0.007) CNSMSP than in usual posture	mental strain.
			Back muscle endurance	Mean back muscle endurance significantly lower (p<0.005) in CNSMSP group	
			Joint hypermobility	Significantly more (p=0.046) hypermobility in CNSMSP	
			Gross motor skills	Gross motor skills were significantly less in CNSMSP group (p=0.028)	
Rees et al. (2011) To determine the relationship between mental health problems and the experience of cervical and lower back pain Mean age: 14.1	Cross- sectional study Data used from Western Australian Pregnancy Cohort (Raine) Study n= 1580 Australia **<u>Setting:</u>** Questionnaire completed on laptop computer at the assessment center as part of a larger study. Questionnaire covering medical, psychosocial and physical topics.	Questionnaire on laptop, including Youth Self Report (YSR) (part of Child Behaviour Checklist (CBCL)). 118 questions from YSR assessing for eight syndromes	Prevalence of cervical and lumbar pain	Boys: NP: 13.8%; LBP: 17.3%; Combination: 9.1% Girls: NP: 17.4%; LBP: 12.9%; Combination 17.6% Combination girls>boys p>0.001	Strong correlation between the experience of cervical and lumbar back pain and the presence of mental health problems. Statistically significant result confirming the associations in both boys and girls. Good sample size, mean age slightly higher than of the current study
			YSR syndrome scores and sex differences	Girls: Significant higher mean for Somatic, Anxious/ Depressed, Thought and attention problem scores (p< 0.001-0.035) Boys: significantly higher mean scores for Rule-breaking scores (p=0.013)	
			Association of YSR syndrome scale scores with monthly prevalence of spinal pain	Participants with somatic symptoms, anxiety/ depression and withdrawal symptoms (all internalization) presented with statistically significant	

				associations with neck pain, back pain and a combination of neck and back pain (p<0.001) Aggression, rule-breaking, social adaption, thoughts and aggression were also all statistically significant with the combination of neck and back pain (p<=0.001)	
Straker et al. (2011) To assess the influence of gender on relationships between computer use, habitual posture and neck/shoulder pain (NSP). Mean age: 14.1	Cross-sectional study Data used from Western Australian Pregnancy Cohort (Raine) Study n= 1483 Australia **Setting:** Data was collected at the Raine study assessment center.	Computer-based questionnaire Physical assessment included measurements of the body, muscle performance, co-ordination and spinal posture in sitting	Prevalence of cervical and shoulder pain	29% reported cervical and shoulder pain in previous month to data collection, females>males	Large representative sample of 14 year old adolescents As study is cross-sectional it did not determine reasons for associations. Even though computer use was observed in the assessment center and not at home or school the outcome did not differ from other studies done in a school environment
			Computer use	Computer use not related to cervical and shoulder pain	
			Posture in sitting	Subjects with prolonged cervical pain (p more than three months, and present in last month) sat with more flexed cervicothoracic angle (p=0.028), more extended trunk angle (p=0.048), increased lordotic lumbar angle (p=0.004) and increased anterior pelvic tilt (p=0.005).	
			Gender	Relationship between cervical and shoulder pain and computer use different in each gender. Increasing in males with increased computer use and decreased risk for females with increased computer use but it was not statistically significant	
Shan et al. (2013) To assess cervical/ shoulder and low back pain in high school	Cross sectional study n= 3016 China **Setting:**	1. Anonymous self-assessment questionnaire	Prevalence	Cervical/ shoulder pain: 40,8%	Large sample size Self- assessment questionnaire asked students to report about
			Age (high school year)	Prevalence increase with grade level (P<0.05)	
			Physical activity	*One hour of exercise each day showed significantly less	

learners as well as possible influences, including digital equipment, physical activity, psychological status Ages: 15-19 year olds	Questionnaires were distributed, completed and collected at different high schools. Thirty schools in Shanghai were randomly selected.			Cervical/shoulder pain (p<0.04) *Satisfaction reported with physical activity reported less pain (p<0.05)	pain the past 6 months- it is a long period for children to remember history of pain. Self-report questionnaire could lead to the wrong answers, as learners might not recall the correct information especially towards physical activity, the use of digital equipment and psychological questions.
			Usage of digital equipment	Mobile phone usage 2hrs+/ day increased prevalence of cervical/shoulder pain (p<0.05) Eye-to-screen distance significant Tablet usage significant to cervical/shoulder pain (p<0.01)	
			Psychological status	Feeling depressed due to academic pressure increased prevalence of cervical/shoulder pain (p<0.05)	
Tobias et al. (2013) To determine if joint mobility is a risk factor in musculoskeletal pain in childhood. Mean age: 13.8y and follow-up at 17.8 years	Prospective study n=2901 Participants were from ALSPAC, a UK Cohort in Avon. England, UK **<u>Setting:</u>** Data was collected in research clinics situated in county of Avon.	At 13.8y: Hypermobility test (Beighton score) was measured at research clinic At 17.8y: Pain questionnaire, socio-economic status, BMI and physical activities were measured	Joint hypermobility (JH) and pain prevalence	Positive relationship (p<0.02) to shoulder, knee and foot pain Higher risk of lower leg pain, thigh pain, chronic regional pain and chronic widespread pain but not statistically significant	Study focused more on joint hyper mobility than musculoskeletal pain. There was no change to spinal pain- therefore joint hypermobility is not a risk factor
			JH, activity and pain prevalence	No significant change in symptoms relationship apart from shoulder pain- weaker relationship with exercise (p>0.05) OR 1.33	
			JH versus pain severity and impact	Strong relation between JH and ankle/foot pain and any pain. No interference of JH and pain with daily activities	
Dianat et al. (2014) -To investigate the occurrence of cervical, shoulder and lower back complaints in relation to carrying of schoolbag and other risk potentials	Cross-sectional study n= 586 Iran **<u>Setting:</u>** The completion of the questionnaire and the	Self-designed Questionnaire. Questionnaire included demographic questions, questions about occurrence of cervical, shoulder and lower back complaints, and questions	Cervical, shoulder and low back pain	59,6% of all children reported cervical, shoulder and low back pain in last month Statistically more girls than boys: Cervical pain: OR=1.94, 95%CI=1.29-2.91, p<0.001	The age of participants is similar to current study. An association was seen between schoolbag weight and cervical pain in more girl than boy subjects. This
			Load carried by	Significant differences in weight	

Age: 12-14y	measurements of the school bag weight, and weight and height of the student took place at 20 different schools in the city of Tabriz.	about the use of a schoolbag as well as transport method Physical investigations: School bag weight, weight and height of student	participants (schoolbag weight as %body weight (BW))	according to grade level but not gender Grade 8 carrying heavier bags than Grade 6 ($p<0.01$) Grade 6 load (%BW) significantly greater than Grade 8 ($p<0.01$)	is similar to other studies. This study is a comprehensive study that includes physical investigations- not only questionnaire. Good sample size
			Time carrying schoolbag	No statistically significant difference	
			Transport method to/from school	No statistically significant difference	
			Association between cervical, shoulder and low back pain and schoolbag load	Schoolbag load associated with cervical pain ($OR=2.10$, 95%CI =1.39-5.30, $p<0.01$) and shoulder pain ($OR=1.69$, 95%CI= 1.23-3.41, $p<0.05$) Lower prevalence of low back pain with satchel than backpack ($OR= 0.68$, 95%CI=0.42-0.89, $p<0.05$)	
Jussila et al. (2014) To determine associations between musculoskeletal pain (neck, shoulder, low back and limb) and time spent in sedentary activities, sleeping, physical activity level, body mass index, alcohol consumption, smoking and emotional and behavioral factors Age: 16 years with baseline assessment and 18 years old at	Cross-sectional study with 2 year follow-up n=1773 Participants were from the 1986 Northern Finland Birth Cohort Study done 2001-2004 Finland **<u>Setting:</u>** Postal questionnaires were sent to subjects in 2001/2002 at age of 16y and again in 2003/4 at age of 18 years. 1773 subjects completed both questionnaires.	Postal questionnaires were used. Questionnaire included questions regarding pain, health habits such as smoking, drinking, sedentary and sporting activities. Youth self report questionnaire (YSR) was used to determine emotional and behavioral factors	Musculoskeletal pain	Pain was described in 6 groups of initial to follow-up pain- minor, intermediate, major pain to minor or major pain. Major to major- 14% girls and 10% boys	Even though it is a 2014 study data was collected 10 years prior to publication A large sample size is a strength of the study. The results of this study correlate to most other studies where there was more pain in girls than boys present. There was also more pain at the 2-year follow-up with respondents older.
			Musculoskeletal pain and health habits	In boys: sitting longer hours ($p=0.004$) and sleeping ($p=0.001$) associated with more pain In girls: Alcohol ($p=0.038$) and physical activities ($p=0.038$) associated with change in pain patterns	
			Musculoskeletal pain and emotional/ behavioural factors	Clear associations among both genders between the internalization (anxious/depressed symptoms,	

follow-up				withdrawn/depressed symptoms and somatic complaints) (p<0.001) and externalization scores (rule-breaking and aggressive behaviour) (p<0.001)	
Myrtveit et al. (2014) - To investigate the prevalence of Neck and shoulder (NSP) in Norwegian adolescents - To investigate the association between NSP and behavioural and psychosocial factors -To investigate the use of health services for adolescents with NSP Ages: 17-19 years	Population based study in 2012 All adolescents born between 1993-1995 in Hordaland, Western Norway, were invited (n=19430) n= 10220 Norway **<u>Setting:</u>** Questionnaires were completed at school. For children not at school the questionnaire was emailed to their homes.	Web-based questionnaire covering broad range of health issues, daily functioning, use of health and social services	Neck or shoulder pain	20% reported NSP (n=1797) (more than once a week), girls 28%; boys 10,7% (p<0.001)	Comprehensive study, all data from web-based questionnaire. Very big sample size- good representation of adolescents in region. Age of participants higher than of current study. Physical activities proven to be protective to pain, more pain in children with poor family economics, screen based activities to play a role.
			Physical activity	Less NSP associated with physical activities. 1-3x/week reduced risk (boys: OR 0.4795%CI 0.35-0.63; girls OR 0.61, 95%ci 0.50-0.73 Performing activities 4-7x /week even more protective	
			Symptoms of depression	Higher score of depressive symptoms increased risk of reporting NSP Girls: OR 3.10, 95% CI 2.65-3.67 Boys: OR 6.14, 95%CI 4.48-8.42	
			Screen based activities	Frequent screen-based activities slightly increase risk for NSP. Adjusted for depression and socio-demographics: Boys: emailing for 2 hrs. + (OR 1.95, 95%CI 1.30-2.92) and both genders playing PC games are statistically significant (boys: OR 1.31, 95%CI 1.06-1.64; girls: OR 1.63 (1.22-2.13).	
			Use of health services	Use of health services statistically significant associated with NSP (p<0.001)	

			Back ground variables	Age and vocational situation non-significant NSP associated with poor family economics (p<0.001 girls, p=0.006 boys)	
Panicker et al. (2014) To assess the prevalence of cervical, shoulder and lower back pain in school going adolescents using schoolbags Ages: 13-15 year old	Cross-sectional study design (Descriptive analysis) n= 727 for questionnaire, 580 for physical testing India **Setting:** The screening, completion of questionnaire and physical measurements took place at 6 different high schools in India. It was not specified in the study where at school the study took place.	1. Screening of learners: exclusion criteria include recent/chronic illness of recent injuries or previous surgeries over cervical area, shoulder, back, abdomen, musculoskeletal pain for more than 6 months. 2. McGill Melzack pain questionnaire 3. Learners meeting inclusion criteria had further assessments: height, weight of student and weight of school bag	Prevalence	19 males and 7 females complaining of NSP or LBP (Prevalence 26/580= 4,5%)	The prevalence of musculoskeletal pain is much less in this study than any of the other studies. This could possibly be due to different way of assessing prevalence (not self- reported questionnaire) The gender relation is also opposite to the other studies with males having a higher prevalence.
			Weight of schoolbag	12 males and 5 females complaining of pain due school bags Moderate correlation between pain and weight of school bag (OR= 0.784)	
Rai et al. (2014) To determine the presence of postural discomfort while using back packs Ages: 10-13 years	Descriptive study with experimental and simple random sampling n= 300 India **Setting:** Data was collected from their homes. An interview took place as well as physical measurements of body weight, body height and school bag weight.	Interview at home. Questions include name, age, class, board, distance of school, mode of transportation, physical characteristics like height, weight and bag weight Reported discomfort recorded on Body Discomfort Chart. Height and weight of participant as well as weight of schoolbag measured	Sharp pain:	Cervical pain: 40.2% male and 33.1% female felt sharp pain	The prevalence of cervical, shoulder and upper back pain was more in male participants. The findings contradict the majority of other studies about gender and pain No associations determined- nothing scientifically proven.
			Radiating pain	In arms 36.6% male and 39% female respondents reported radiating pain	
			Pins and needles	41.5% males and 45.6% females complained of pins and needles pain.	
			Use of school back pack	Prevalence of postural complaints of school children was high.	

Ruivo et al. (2014) -To characterize postural alignment of head and shoulders in erect standing -To determine relationship between posture and neck and shoulder pain -To analyze the difference in postural angles and neck and shoulder pain of both genders Age: 15-17 year old	Cross-sectional study n=275 Portugal **Setting:** Data collection was done at two public secondary schools in Lisbon.	1. Firstly, erect standing posture was measured with photogrammetry and postural assessment software. 2. Secondly, ASES (American Shoulder and Elbow surgeons Shoulder Assessment) was used to assess shoulder and cervical pain and function 3. Students were asked to answer the question: ”Do you feel neck pain regularly?”	Prevalence of cervical and shoulder pain	38% reported feeling neck pain regularly Cervical pain was more prevalent in learners with a lower cervical angle (CV) (forward head posture) 29.8% vs. 8.4%	Study age higher than current study Study age higher so also more associated with higher prevalence of pain due to age (Aartun et al. 2014)
			Cervical and shoulder postural measurements	68% presented with forward head posture 58% presented with protracted shoulders	
			Gender	Girls presented with lower resting CV than boys- thus more forward head posture (46.5º vs 48.4º). More girls than boys complained of cervical pain: 52.9% vs. 19% Association present between girls with lower CV and cervical pain (p=0.0048)	
Brink et al. (2015) To investigate the relationship between sitting posture and seated-related upper quadrant musculoskeletal pain (UQMP) in computing adolescents Age: 15-17 year olds	Prospective study amongst high school learners in first year of taking computer classes n= 211 South Africa **Setting:** Postural assessment was performed in the school computer classroom.	Sitting posture measured with 3D Posture analysis tool (3D-PAT) in classroom 21-item Beck Depression Inventory (BDI) for depression and 39-item Multidimensional Anxiety Scale for Children (MASC) to determine anxiety Computer usage questionnaire to	Presence of UQMP (areas included head, neck, upper back, bilateral shoulders, elbow and wrists)	Over 12-month follow-up area 127/190 students had 0 for pain score thus 34,2% students complained of upper quadrant musculoskeletal pain.	Findings contradict other research regarding anxiety and depression as no significant difference was found between anxiety, depression and cervical pain. Could possibly be due to the nature of study and inclusion criteria. Results correlate with other findings about cervical pain and posture.
			Factors associated with UQMP (UQMP at 80^{th} and 90^{th} percentile)	Head flexion was associated with UQMP on 90^{th} percentile (p=0.003) Head flexion was significant predictor of seated related UQMP, linear association between HF and UQMP No significant difference in mean values for computer use, anxiety or depression	

		determine computer hours and pain due to computer usage. Pain section of Computer Usage Questionnaire was completed at 6 month and 1 year follow-up	Postural angle combinations	Combination of head flexion and cranio-cervical angles was a significant predictor for pain at 90th percentile of the pain score (p=0.0004)	
Gustafsson et al. (2017) The aim was to determine if texting is a risk factor for musculoskeletal disorders in cervical and upper extremities in young adults Ages: 20-24 years	5 year longitudinal cohort study n= 7092 at baseline, n=4148 at 1-year follow-up n=2724 at 5 year follow-up Sweden **<u>Setting:</u>** Initial web-based questionnaire 2 follow-up questionnaires were identical (1-year and 5-years)	1. Self-reported web-based questionnaire at baseline, one year and five year follow-up	Prevalence of cervical pain	Cervical pain more than 3 months Women: baseline 18%, follow-up 22% Men: baseline: 8%, follow-up 10%	**The age of the study population is higher than the inclusion material but due to the relevancy to the current study is was included.** Baseline data were collected in 2007, which makes the data old and not completely representative of current phone usage and text messaging. The sample group was large and sufficient for data collection. The participants were older than adolescents but nowadays adolescents are exposed to texting more than 10 years ago (Müller et al. 2015)
			Texting	Baseline data: association between texting (>20 texts a day) and neck pain (OR1,4 women and OR 2,0 for men) At follow-up: -Pain-free participants at one year follow-up: association between high volume messages (20+/day) and numbness/tingling of hands (OR=2.0) Symptomatic baseline participants: association between high volume of text messaging (20+/day) and neck/upper back pain (OR=1.6). Associations were also found between lower volumes of texting (up to 6/day) and neck/ upper extremity pain (OR=1.4)	

Annexure B

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

PARTICIPANT NUMBER:…………….. **GENDER: Male/ Female**

PARENT/GUARDIAN INFORMATION & INFORMED CONSENT

Dear parent/ guardian

1) INTRODUCTION

We have invited your child to participate in a research study. This information leaflet will help you to decide if you want your child to participate. Before you agree for your child to take part you should fully understand what is involved. If you have any questions that this leaflet does not fully explain, please do not hesitate to ask the investigator, Annelie van Heerden.

2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to determine if there is an association between neck pain and the way the neck and shoulder blades are positioned and move. As neck pain is present in at least one in every five high school learners, your child as a Grade 7 learner, is a very important source of information on neck pain and neck and shoulder movements in younger learners.

3) EXPLANATION OF PROCEDURES TO BE FOLLOWED

This study involves completing an information questionnaire, a pain questionnaire and three movement tests. A video recording of the movement tests will be done.

The information sheet contains questions about physical activity, time spent in front of the television, laptop or any other electronic device as well as a few questions on general health, sport participation and the use of a school bag.

The pain questionnaire will be to determine if any neck or shoulder pain is present as well as how it is affecting your child at school and when doing physical activities.

The movement tests involve asking your child to lift his/her arms up while we will observe the movements of the neck and shoulder blades. We will also observe the posture of your child's neck and shoulder blades. The last test will be a push up on the floor.

4) RISK AND DISCOMFORT INVOLVED

There are no risks in participating in the study.

The active movement tests may cause minimal discomfort due to muscle fatigue.

The physical assessment includes analysis of your child's posture and your child will have to remove his/her shirt. Girls will be assessed in an appropriate gym top with shorts to prevent discomfort. The boys will be assessed in a pair of shorts. All children will wear masks during the video recordings to prevent face recognition.

The full session- personal information, pain questionnaire and active movement tests- will take approximately 20 minutes.

5) POSSIBLE BENEFITS OF THIS STUDY

Your child will benefit directly from this study because at the end we will provide every child with an information session and leaflet on posture and upper body exercises.

6) WHAT IS YOUR CHILD'S RIGHT AS A PARTICIPANT

Your child's participation in this study is entirely voluntary. Your child can refuse to participate or to stop at any time during the study. Your child's withdrawal will not affect you or your child in any other way.

7) HAS THE STUDY RECEIVED ETHICAL APPROVAL?

This study is awaiting written approval from the Research Ethics committee of the Faculty of Health sciences at the university of Pretoria, telephone numbers 012 354 1677/ 012 354 1330.

8) INFORMATION AND CONTACT PERSON

The contact person for the study is Annelie van Heerden. If you have any questions about the study please contact her on 076 930 8666. Alternatively you may contact the study leader on 012 354 2023.

9) COMPENSATION

The participation is voluntary. No compensation will be given for your child's participation.

10) CONFIDENTIALITY

All information that your child gives will be kept strictly confidential. Once we have analysed the information no one will be able to identify you. Research reports and articles in scientific journals will not include any information that may identify your child or his/ her school.

The data from the video recordings will be stored on CD and an external hard drive that will be kept safe at the university. No video recordings will be stored on any personal laptops, computers or mobile devices. This is to prevent any access to the images via the Internet or by hackers.

CONSENT TO PARTICIPATE IN THIS STUDY

I confirm that the person asking my consent for my child to take part in this study has told me about the nature, process, risks, discomforts and benefits of this study. I have also received, read and understood the above written information (Information leaflet and Informed Consent) regarding the study. I am aware that the results of the study, including personal details, will be anonymously processed into research reports. I am letting my child participate willingly. I have had time to ask questions and have no objection to my child participating in the study. I understand that there is no penalty should my child or I wish to discontinue with the study and my child's withdrawal will not have a negative affect in any way.

I have received a signed copy of this informed consent agreement.

Participant's name:……………………………………………………(please print)

Parent's/ guardian's name:…………………………………………..(please print)
Parent's/ guardians signature:…………………………………………
Date:…………………………………………..

Investigator's name:………………………………….…………(please print)
Investigator's signature:……………………………………Date:……………

Witness' name:…………………………………………………..…(please print)
Witness' signature:……………………………………….…....Date:………….

VERBAL INFORMED CONSENT

I, the undersigned, have read and have fully explained the participant information leaflet, which explains the nature, process, risks, discomforts and benefits of the study to the participant's parent/guardian whom I have asked to participate in the study.

The participant's parent/ guardian indicates that s/he understands that the results of the study, including personal details regarding the information form will be anonymously processed into a research report. The participant's parent/guardian indicates that s/he has had time to ask questions and has no objection with his/her child's participation in the study. S/he understands that there is no penalty if the child wishes to discontinue with the study and the child's withdrawal will not have any negative effect in any way. I hereby certify that the client has agreed to participate in this study.

Participant's parent/guardian's

Name:…………………………………………………………………………………………..…

(please print)

Person seeking consent:………………………………………………………………………..

(please print)

Signature:……………………………………….. Date:……………………..

Witness' name……………………………………………………………………….………

(please print)

Signature:……………………………………….. Date:………………………..

Annexure C

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

PARTICIPANT NUMBER:……………….GENDER: Male/ Female

GRADE 7 LEARNER ASSENT FORM

Please read through the form carefully before signing

We wish to know if you would like to volunteer to be part of a research study to see if there is a link between neck pain and the shoulder muscles and the way you move your neck and arm. We are asking you because previous research has found that about one in every five children get neck pain when they are in high school. This study will help us gather information on how many children already have neck pain in grade 7 and if there is a link between the neck and shoulder blade movements and neck pain.

About 140 children are going to take part in this study and all the movement tests will be done in one day. We will visit your school in the third term and the tests will be done at school.

We would like you to complete a questionnaire before you see the physiotherapists at school. This form will contain questions that specifically look at what sport and other after-school activities you take part in. Furthermore, there will be other questions that will help us find any other reasons that could contribute to neck pain.

At school you will see three physiotherapists. They will give you a pain questionnaire to complete. The boys will be asked to take off their shirts and girls will be given a gym top to wear while the therapists look at your neck and shoulder position. The therapist will write your unique participant number on your right arm and right shoulder blade with an eyeliner pencil. The pencil will also be used to make marks on certain bony points of the body that we need to assess.

We will be doing a video recording of all the movement tests. You will be asked to wear a mask during the video recordings. This will hide your identity and ensure that no one will be able to recognize you.

You will be asked to do arm movements while the therapist record the shoulder and neck movements. Lastly, the therapists will ask you to do a push up exercise on your knees. You will have to tell us how easy or difficult it was. The therapists might touch your shoulder blades to make sure they note the right position but there will be no other contact with your body. You might have arms that feel a bit tired after the arm movements but that should not last for more than one day.

All the video recordings will be saved on a special CD and stored in a safe place at the university. It will not be on anyone's computer so no one will be able to get access to it through the Internet.

If you do not want to take part you may decide at any time during the study not to carry on. No one will force you to carry on. No one will be cross or upset with you if you don't want to continue with the study. You don't have to give your answer now, take your time and read the rest of this form before you decide.

If you sign at the bottom it means that you have read this paper, that you understand everything explained/ written in the paper and that you would like to be part of this study.

	Your name	**Person obtaining Consent**	**Parent/ Guardian/ teacher as witness**
NAME (PLEASE PRINT)			
Signature			
Date			

Annexure D:

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

PARTICIPANT NUMBER:………………

<u>Personal information questionnaire</u>

This questionnaire is related to the neck and shoulder. Other questions asked have been proven in research to have an influence on the neck and shoulder. Use only one cross (X) to answer each question unless indicated otherwise

Please answer all the questions.

Age		
Name of school		
Sex	Male	Female

Do you have any health problems?	Yes	NO
If yes, please specify		

Do you take any prescribed medication?	Yes	No
If yes, please specify		

Have you had any operations?	Yes	No
If yes, please specify		

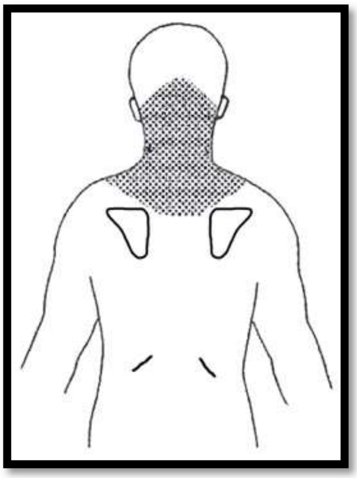
Do you have any allergies?	Yes	No
If yes, please specify		

Do you ever get headaches?

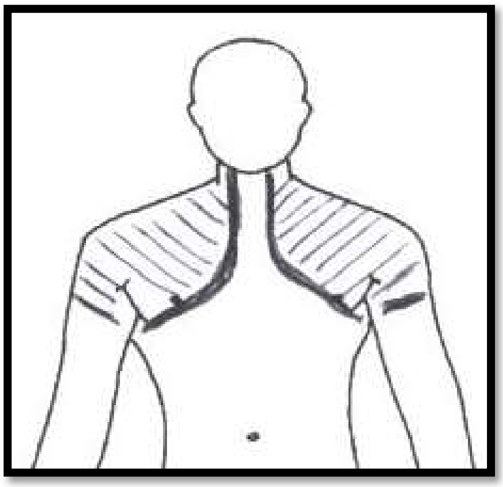
Never	Almost never	Sometimes	Often	Always

Neck and Shoulder pain:

This is your neck: **These are your shoulders:**



Person seen from behind



Person seen from the front

Have you ever **injured** your **neck or shoulders** in the past?

Yes	NO
If yes, please specify?	

Have you had any **operations** on your **neck or shoulders**?

Yes	No
If yes, Please specify?	

Have you had **neck pain** in the **last three (3) months**?

Yes	No
If yes, please specify?	

Have you had **shoulder pain** in the **last three (3) months**?

Yes	No
If yes, please specify?	

Are you currently **taking any painkillers** for neck or shoulder pain?

Yes	No

Are you **currently receiving** treatment for your neck/shoulders?

Yes	No

If yes, please specify treatment received?

Physiotherapy	Biokinetics	Chiropractor	Other
Please specify?			

School bag:

How much time do you spend carrying your school bag each day?

Less than 5min	5-10 min	10-15 min	15-30 min	30 min or more

How do you carry your school bag?

Both shoulders	One shoulder	Pulling a caddy bag

How often does it feel like your schoolbag is too heavy?

Never	Almost never	Sometimes	Often	Always

School

What are your normal school hours?

Start:…………….……………… End:……………………………….…

How **long** are your class periods?

Less than 30min	30-40 min	40-50 min	50-60min	60 min plus

How **often** do you spend time on a **laptop/ computer/ tablet** at school?

Never	Once a week	2-3 days	4-5 days

How **much time** do you spend on a **laptop/ computer/ tablet** at school?

Less than 1 hr per day	1-2 hrs per day	3-4 hrs per day	5 hrs plus per day

Homework

How often do you do **homework/ studying after school**?

Never	Once a week	2-3 times a week	4-5 times a week	6-7 times a week

How **much time** do you spend doing homework/ studying after school?

Less than 1 hr per day	1-2 hrs per day	3-4 hrs per day	5 hrs plus per day

How often do you spend time on a **computer/ laptop/ tablet** for **homework/ studying/ projects?**

Never	Once a week	2-3 times a week	4-5 times a week	6-7 times a week

How much time do you spend on a **computer/ laptop/ tablet** for **homework/ studying/ projects?**

Less than 1 hour	1-2 hours	3-4 hours	5 hours plus

Reading

How often do you read (Novels, non-fiction) for recreation (fun)?

Never	Once a week	2-3 times a week	4-5 times a week	6-7 times a week

How much time do you spend reading at a time?

Less than 1 hour	1-2 hours	3-4 hours	5 hours plus

Sport participation Please complete where appropriate.

Do you participate in any sport?

Yes	No

If yes, how many times a week do you participate in sport?

1-3 times a week	4-6 times a week	7 days a week

How many hours at a time?

Less than 1 hour/day	1-2 hours/ day	2 hours plus/ day

Other extra-mural activities

Do you participate in any other extra-mural activities e.g. ballet, dance, musical instruments, art lessons, and chess?

Yes	No

If yes, how many hours per week do you participate in these activities?

1-3 times a week	4-6 times a week	7 days a week

How many hours at a time?

Less than 1 hour/ day	1-2 hours/ day	2 hours plus/ day

Recreation

How **often** do you **play games** on a **tablet/ games consoles (PSP / Nintendo DS)/ Smart phone/ Tablet device)**

Never	Once a week	2-3 times a week	4-5 times a week	6-7 times a week

How **much time** do you spend on playing games on a tablet/ game console at a time?

Less than 1 hour	1-2 hours	3-4 hours	5 hours plus

How often do you play TV games/ Sony Playstation / X box?

Never	Once a week	2-3 times a week	4-5 times a week	6-7 times a week

How much time do you spend on playing TV games /playstation/X-box at a time?

Less than 1 hour	1-2 hours	3-4 hours	5 hours plus

Do you have your own smart phone or tablet device?

Yes	No

How much time do you spend on your smart phone or tablet per day?

Less than 1 hour	1-2 hours	3-4 hours	5 hours plus

How often do you watch television?

Never	Once a week	2-3 times a week	4-5 times a week	6-7 times a week

How much time do you spend watching TV at a time?

Less than 1 hour	1-2 hours	3-4 hours	5 hours plus

Thank you for completing the questionnaire

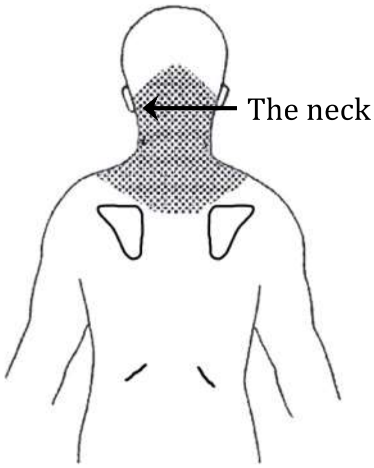
CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

PARTICIPANT NUMBER:…………………GENDER: Male/ Female

<u>Adapted Young Spine Pain Questionnaire</u>

This questionnaire is related to the neck and shoulder. Use only one cross (X) to answer each question. Please answer ALL questions.

1. The neck is shown in the picture



Person seen from behind

1a. How often do you have pain in the neck?
- ☐ Often
- ☐ Once in a while
- ☐ Once or twice
- ☐ Never

1b. Have you had neck pain in **the last week**?
- ☐ Yes
- ☐ No

1c. Do you have neck pain **today**?
- ☐ Yes
- ☐ No

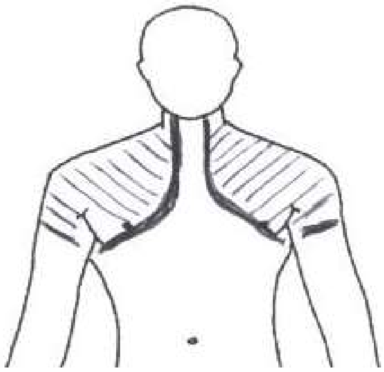
On a scale from 0-10 please indicate how bad your pain is:

Zero (0) means NO PAIN
Ten (10) means WORST PAIN IMAGINED

1d. Put a cross (X) on the number that shows how much pain you have had in the neck when it was at its worst.

0	1	2	3	4	5	6	7	8	9	10

2. **The shoulders are shown in the picture below**



Person seen from the front

2a. How often do you have pain in the shoulders?
- ☐ Often
- ☐ Once in a while
- ☐ Once or twice
- ☐ Never

2b. Have you had shoulder pain in **the last week**?
- ☐ Yes
- ☐ No

2c. Do you have shoulder pain **today**?
- ☐ Yes
- ☐ No

On a scale from 0-10 please indicate how bad your pain is:

Zero (0) means NO PAIN
Ten (10) means WORST PAIN IMAGINED

1d. Put a cross (X) on the number that shows how much pain you have had in the shoulders when it was at its worst.

0	1	2	3	4	5	6	7	8	9	10

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

PARTICIPANT NUMBER:………………GENDER: Male/ Female

PHYSICAL TEST MARK SHEET

1. POSTURE ANALYSIS:

Table 1: Ideal Posture markers

Head	Head position neutral, not tilted forwards or back
Cervical Spine	Normal curvature, slightly convex anteriorly
Scapulae	Flat against the thoracic chest wall
Thoracic spine	Normal curve, slightly convex posterior
Lumbar Spine	Normal curve, slightly convex anterior
Pelvis	Neutral position, ASIS in line with symphysis pubis
Hip Joints	Neutral position
Knee joints	Neutral position
Ankle joints	Neutral position- leg vertical and at right angle to sole of foot

Table 2: Recording of posture observed:

Anatomical landmark	Ideal	Deviance
	Yes/no	Anterior/posterior
Through lobe of ear		
Through bodies of cervical vertebrae		
Through shoulder joint		
Approx. midway through trunk		
Approx. through greater trochanter		

Slightly anterior to midline through knee		
Slightly anterior to lateral malleolus		Fixed point of reference

2. SCAPULA POSITION:

Table 3: Static scapula position

Scapula landmark	**Ideal position**	**Scapula position (✓□)**	
		Left	**Right**
Root of scapula spine	Level to T3 projecting to T4		
Inferior angle relation to superior angle	Inferior angle should be lateral to superior angle		
Medial border position	Parallel to Thoracic spine		
Inferior angle	Against thoracic wall in line with T7-9		
Position of the spine of the scapula	Angled upwards		

Table 4: Observation of deviations in resting scapula position

Observation/ Deviation	Explanation	Tick (□ □)	
		Left	Right
Scapula tipping	Inferior angle prominence		
Scapula winging	Medial border winging (more than two-thirds of the medial border)		
Pseudo winging	Inferior third medial border winging		
Symmetry of the scapulae			

3. SCAPULA DYSKINESIS TEST

Observation will take place during arm abduction. ***ONLY rate the fifth (5th) repetition***

Table 5: Scapular dyskinesis test

Observation	Explanation	Tick (□ □)	
		Left	Right
Scapula tipping	Inferior angle prominence		
Scapula winging	Medial border winging (more than two-thirds of the medial border)		
Dysrhythmia	Premature/excessive elevation/protraction/ nonsmooth motion of scapula		
Symmetry of scapulohumeral rhythm (no dyskinesis)			

Table 6: Rating of scapular dyskinesis

Rating of scapular dyskinesis	Tick (□ □)	
	Left	Right
Normal motion		
Subtle abnormality		
Obvious abnormality		

4. OVERHEAD ARM LIFT TEST

Very important:

Therapist must correct the participant's head and neck position as well as scapular placing.

Once participant is in a neutral position the participant must aim to keep it there while doing the overhead arm lift test.

Rate only the fifth (5^{th}) repetition of the arm movements

Table 7. Rating of Overhead Arm Lift Test

Aspects assessed during Overhead Arm Lift Test	Tick (□ □)
1. Able to prevent UCM into multi-segmental or single segment cervical flexion (only flexion, no rotation or any other movement)	
2. Dissociate movement through benchmark range of 180º bilateral shoulder flexion (if more available range look only at benchmark range for control)	
3. Without holding breath	
4. Control during eccentric phase	
5. Control during concentric phase	

Score Y: N: (is there low cervical control present or not)

Table 8: Additional movements observed

Please mention if there is any other movements that were observed during the overhead arm lift test (upper cervical, trunk, scapulae)

Annexure E

The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.
- FWA 00002567, Approved dd 22 May 2002 and Expires 20 Oct 2016.
- IRB 0000 2235 IORG0001762 Approved dd 22/04/2014 and Expires 22/04/2017.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences Research Ethics Committee

20/09/2016

Approval Certificate
New Application

Ethics Reference No.: 275/2016

Title: Cervical pain and the association thereof with scapula and cervical dyskinesis in Grade 7 learners in private schools in Tshwane

Dear Annelie Van Heerden

The **New Application** as supported by documents specified in your cover letter dated 17/09/2016 for your research received on the 19/09/2016, was approved by the Faculty of Health Sciences Research Ethics Committee on its quorate meeting of 20/09/2016.

Please note the following about your ethics approval:
- Ethics Approval is valid for 1 year.
- Please remember to use your protocol number (**275/2016**) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, or monitor the conduct of your research.

Ethics approval is subject to the following:
- The ethics approval is conditional on the receipt of **6 monthly written Progress Reports**, and
- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely

*** Kindly collect your original signed approval certificate from our offices, Faculty of Health Sciences, Research Ethics Committee, Tswelopele Building, Level 4-60*

Dr R Sommers; MBChB; MMed (Int); MPharMed,PhD
Deputy Chairperson of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health).

012 356 3084 deepeka.behari@up.ac.za http://www.up.ac.za/healthethics
Private Bag X323, Arcadia, 0007 - Tswelopele Building, Level 4, Room 60, Gezina, Pretoria

Annexure F

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

Permission to conduct a research study at Hatfield Christian School

To: The Headmaster and/or
The Chief Executive officer
School Governing Body
Mr. Tony Pienaar

From: The Investigator
University of Pretoria
Physiotherapy Department
Mrs A van Heerden

Re: Permission to do research at Hatfield Christian School

I am a Masters student at the Department of Physiotherapy, University of Pretoria. I am requesting permission on behalf of 2 physiotherapy colleagues and myself to conduct a study on the school premises.

The request is lodged with you in terms of the requirements of the promotion of Access to Information Act No. 2 0f 2000.

The title of the study is: The prevalence of cervical pain and the association thereof with scapula and cervical dyskinesis in Grade 7 learners in Pretoria

The researchers request access to all Grade 7 learners at your school. We intend to assess posture, neck and shoulder movements during the study. We intend to protect the personal identity of the learners by assigning every learner a random number code. As we will be doing video recordings of the pupils special measures will be taken to ensure confidentiality: The students will be wearing masks to hide their faces, the girls will be dressed in appropriate gym tops with shorts, the boys dressed in sports shorts.

We intend to publish the findings of the study in a professional journal and/ or at professional meetings like symposia, congresses, or other meetings of such nature.

We undertake not to proceed with the study until we have received approval from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria.

i

Yours sincerely

Annelie van Heerden (Principle investigator)

Permission to do the research study at this school and to access information as requested, is hereby approved.

HATFIELD CHRISTIAN SCHOOL
PO BOX 33760
Glenstantia 0010
Tel. (012) 361-1182 / 348-2970
Fax. (012) 348-9385

Official Stamp
School

Head Master / Chief Executive Officer

Hatfield Christian School

Mr. Tony Pienaar

Signature of Headmaster/CEO

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

Permission to conduct a research study at Southdowns College

To: The Headmaster and/or
The Chief Executive officer
School Governing Body
Mr. Mark Smith

From: The Investigator
University of Pretoria
Physiotherapy Department
Mrs A van Heerden

Re: Permission to do research at Southdowns College

I am a Masters student at the Department of Physiotherapy, University of Pretoria. I am requesting permission on behalf of 2 physiotherapy colleagues and myself to conduct a study on the school premises.

The request is lodged with you in terms of the requirements of the promotion of Access to Information Act No. 2 0f 2000.

The title of the study is: The prevalence of cervical pain and the association thereof with scapula and cervical dyskinesis in Grade 7 learners in Pretoria

The researchers request access to all Grade 7 learners at your school. We intend to assess posture, neck and shoulder movements during the study. We intend to protect the personal identity of the learners by assigning every learner a random number code. As we will be doing video recordings of the pupils special measures will be taken to ensure confidentiality: The students will be wearing masks to hide their faces, the girls will be dressed in appropriate gym tops with shorts, the boys dressed in sports shorts.

We intend to publish the findings of the study in a professional journal and/ or at professional meetings like symposia, congresses, or other meetings of such nature.

We undertake not to proceed with the study until we have received approval from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria.

Yours sincerely

Annelie van Heerden (Principle investigator)

Permission to do the research study at this school and to access information as requested, is hereby approved.

Head Master / Chief Executive Officer
Southdowns College

Official Stamp
School

SOUTHDOWNS
COLLEGE
Enlightened Minds
P.O. BOX 158
SOUTHDOWNS
0123
TEL: 012-665-0244
FAX: 012-665-3735

Signature of Headmaster/CEO
Mr. Mark Smith

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

Permission to conduct a research study at Curro Soshanguve

To: The Headmaster and/or	From: The Investigator
The Chief Executive officer	University of Pretoria
School Governing Body	Physiotherapy Department
Curro Soshanguve	Mrs A van Heerden

Re: Permission to do research at Curro Soshanguve

I am a Masters student at the Department of Physiotherapy, University of Pretoria. I am requesting permission on behalf of 2 physiotherapy colleagues and myself to conduct a study on the school premises.

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Yours sincerely

Annelie van Heerden (Principle investigator)

Permission to do the research study at this school and to access information as requested, is hereby approved.

Head Master / Chief Executive Officer
Curro Soshanguve

Signature of Headmaster/CEO

Palladium Street
Block VV
Soshanguve East X 6
PO Box 1021
Soshanguve, 0164
T 087 285 4701

CURRO
Academy
Soshanguve

Official Stamp
School
15 SEP 2016

Executive Head
www.curro.co.za
E info.soshanguve@curro.co.za

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UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

CERVICAL PAIN AND THE ASSOCIATION THEREOF WITH SCAPULA AND CERVICAL DYSKINESIS IN GRADE 7 LEARNERS IN PRETORIA

Permission to conduct a research study at Maragon Olympus

To:	The Headmaster and/or	From: The Investigator
	The Chief Executive officer	University of Pretoria
	School Governing Body	Physiotherapy Department
	Mr. Philip Brand	Mrs A van Heerden

Re: Permission to do research at Maragon Olympus

I am a Masters student at the Department of Physiotherapy, University of Pretoria. I am requesting permission on behalf of 2 physiotherapy colleagues and myself to conduct a study on the school premises.

The request is lodged with you in terms of the requirements of the promotion of Access to Information Act No. 2 0f 2000.

The title of the study is: The prevalence of cervical pain and the association thereof with scapula and cervical dyskinesis in Grade 7 learners in Pretoria

The researchers request access to all Grade 7 learners at your school. We intend to assess posture, neck and shoulder movements during the study. We intend to protect the personal identity of the learners by assigning every learner a random number code. As we will be doing video recordings of the pupils special measures will be taken to ensure confidentiality: The students will be wearing masks to hide their faces, the girls will be dressed in appropriate gym tops with shorts, the boys dressed in sports shorts.

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We undertake not to proceed with the study until we have received approval from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria.

Yours sincerely

Annelie van Heerden (Principle investigator)

Permission to do the research study at this school and to access information as requested, is hereby approved.

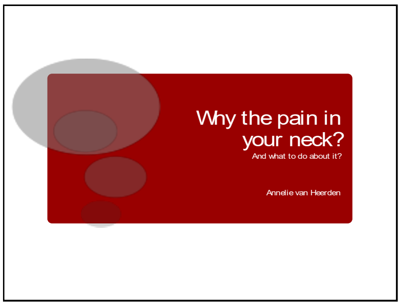
Head Master / Chief Executive Officer
Maragon Olympus

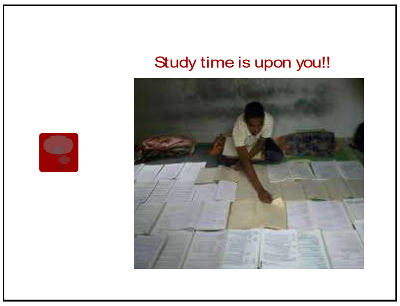
Signature of Headmaster/CEO
Mr. Philip Brand

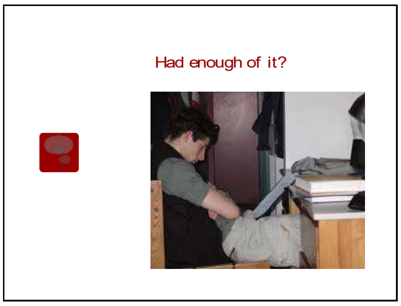
Official Stamp
School

MARAGON PRIVATE SCHOOLS
OLYMPUS
TEL:(012)991 0756 FAX:(012)991 8864
2016 -09- 09
P.O. BOX 1801, FAERIE GLEN, 0043
PLOT 7 OLYMPUS A/H, PRETORIA

Annexure G

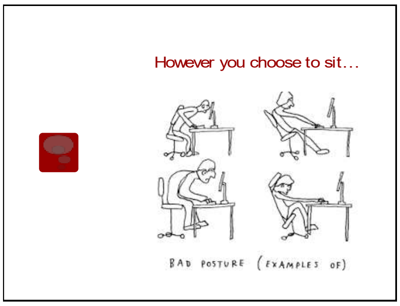

Why the pain in your neck?
And what to do about it?
Annelie van Heerden


Study time is upon you!!


Had enough of it?


Dreaming of the beach?


Whatever way you manage to do it…


However you choose to sit…
BAD POSTURE (EXAMPLES OF)

Even with the perfect workspace…

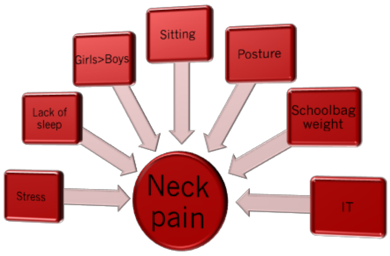
You may experience neck pain!

What do the statistics say?

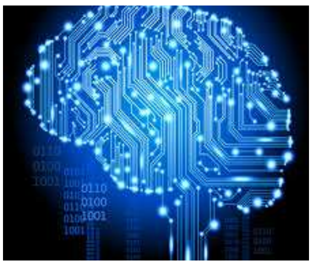
- At least 20% of teenagers get neck pain
- The percentage increases into later teenage years
- Chances are that if you just leave it you could continue having pain till you are an adult and that pain will persist throughout adulthood!

- **BUT WHY DO TEENAGERS GET NECK PAIN???**

Research says:

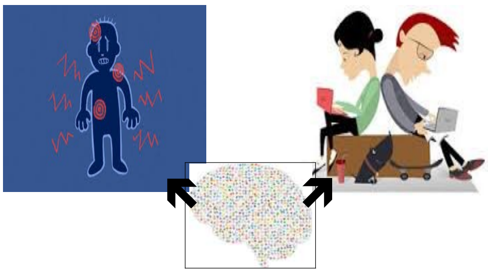


Why does pain continue?



Brain associations

- Pain
- Sitting



Neurotags- brain associations

- Eg. Smell of fresh bread
- Group of nerves firing together in a specific situation- using senses, sensation,

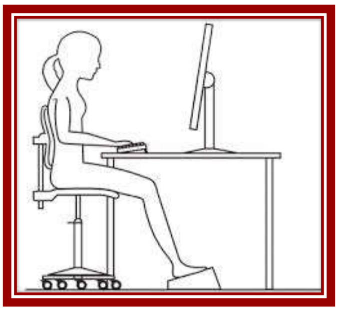
- Neuroplasticity:
- Connections become stronger, work faster
- Neural precision
- Neurons becoming more precise- riding a bike
- working faster, happening sooner
- Neural mass
- Bigger areas in brain starts working together

How to prevent and get rid of neck pain?

Posture

- Head nod "YES"
- Neck long
- Chin down
- Shoulders open
- Breath wide

Ideal sitting posture:



Head in line with top of laptop
Sitting close to the desk
Elbows bend 90°
Back against back rest with lumbar support
Feet on small step if needed

School bag

School bag

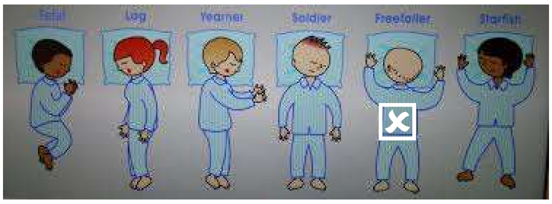
BEST WAY TO CARRY IT???

WEIGHT???

- Studies say anything between 5% and 20%of body weight
- 10-15% of body weight is the best
- Most important:

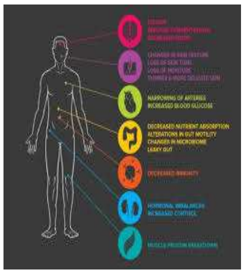
If it feels heavy to YOU it is more likely that it will cause you pain

Sleep position and duration

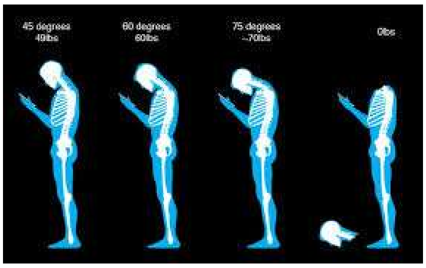


- 8 ½ - 9 ½ hours per night
- It doesn't matter how much you sleep as long as you **THINK** you sleep enough!

Stress



Text neck?



Text neck

Neck pain from looking down at your cellphone, tablet, or other wireless devices too often and for too long

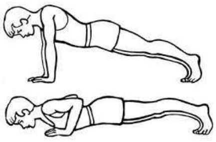
So what do you have to do to prevent this?

- Text less!
- Lift your phone to level of your eyes
- Keep neck long and look down your eyes
- Use audio recorder
- Take regular breaks

Exercises

- Push ups
- Pull ups
- Planks

Most important the position of your neck and shoulders while doing the exercises

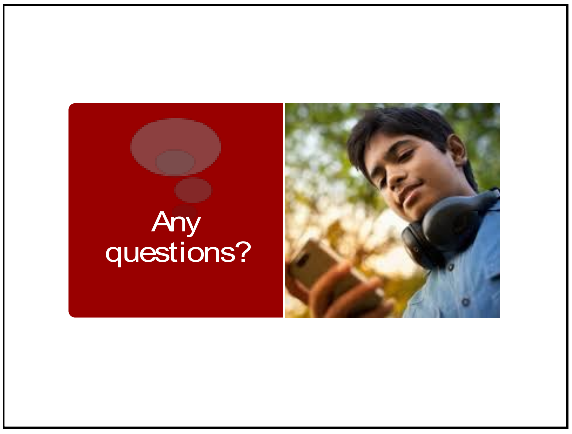


Activities

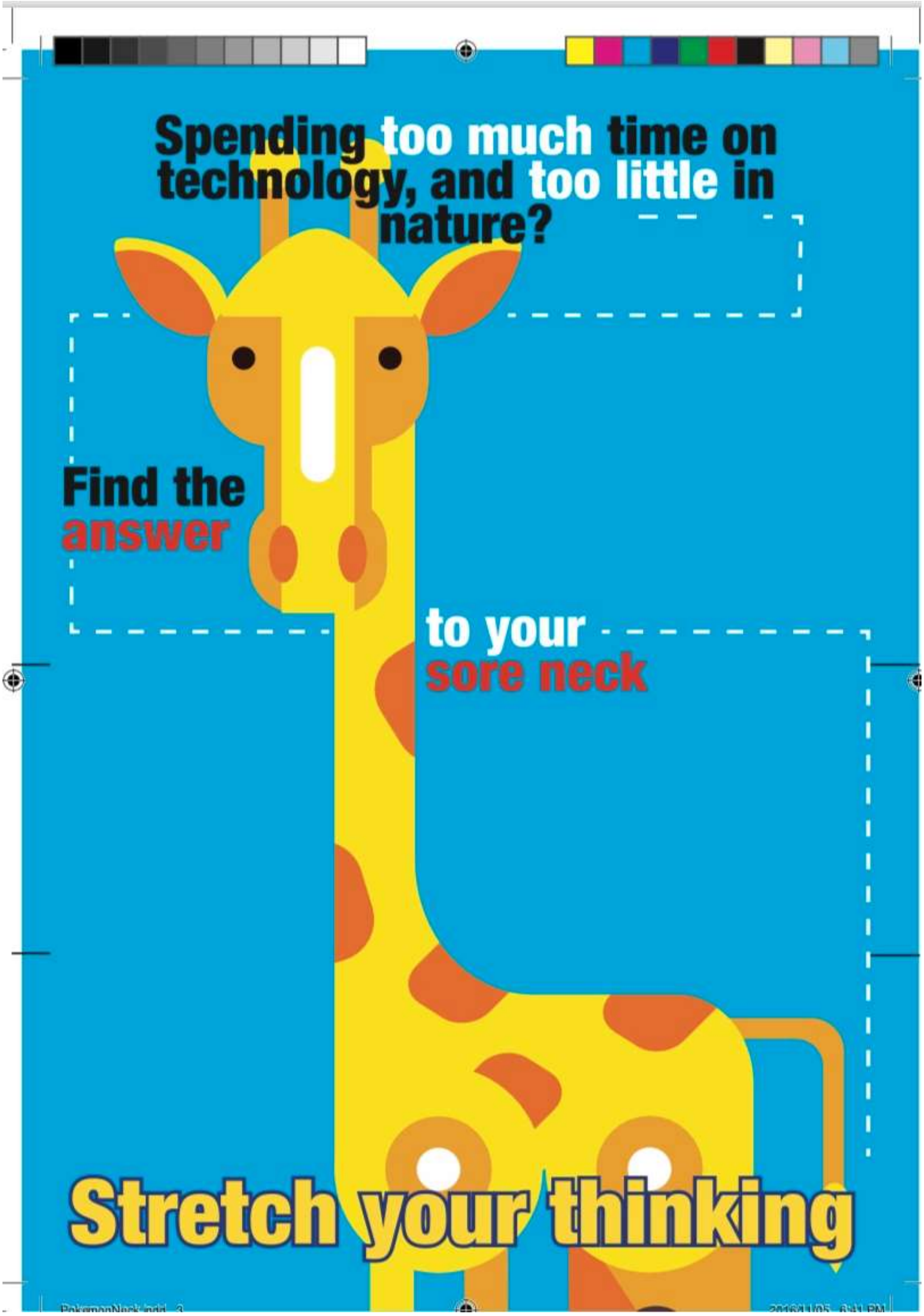
- Gymnastics
- Wrestling
- Rowing
- Wall climbing


Stress
Aerobic exercises
Deep breathing
Praying and being quiet
Sleep enough


THANK YOU FOR
LISTENING


Any
questions?

Annexure H



Spending too much time on technology, and too little in nature?
Find the answer
to your sore neck
Stretch your thinking

Do you suffer from any of these symptoms?

Headaches
Pain in the neck and shoulders
Curvature of the spine (especially children)

If so you have text neck!

No we're not joking with you. Remember these things to keep your growing back and neck healthy.

Use **voice whenever possible** – put the loudspeaker on when you chat, use voice recognition apps.
Bend your eyes down to see the screen rather than your neck.
Bring the phone up so you're looking at it head-on instead of at an angle
Text less (yes, it's possible!)
Aim for **good posture**, like this:
Imagine someone is standing over you, holding your head up by a string attached to the top of your head. Keep your chin tucked in. ***That?*** That's good posture!

EXERCISSSSSE

Try these:
Push-ups, planks, pull-ups and dips
Activities such as swimming, rowing and climbing will strengthen your shoulders and help support your neck

And to avoid falling, crashing into poles and running into traffic,

please, **put the phone DOWN,** get out there and spend some time with nature.